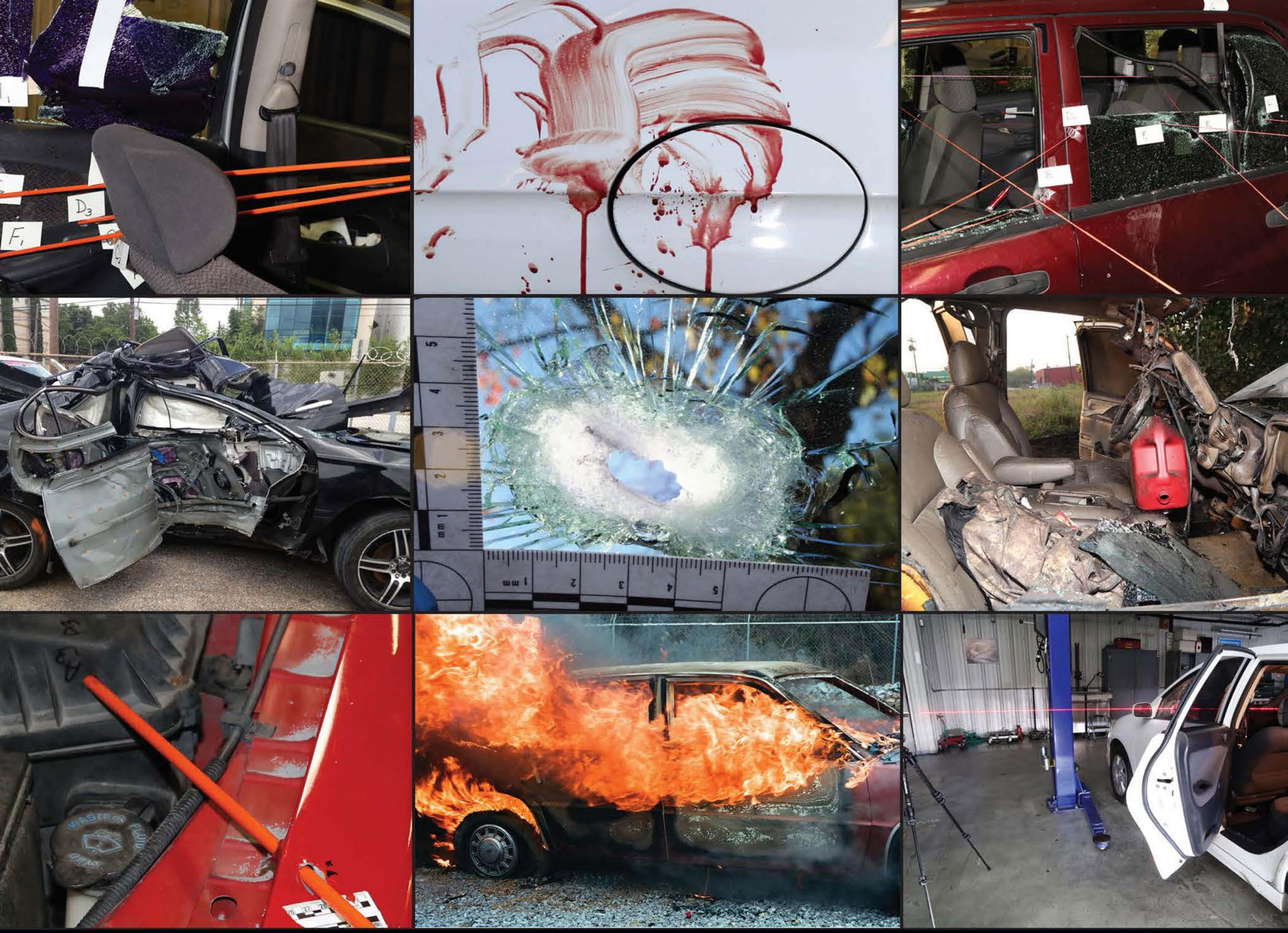

Processing Vehicles Used in Violent Crimes for Forensic Evidence

Christopher D. Duncan

CRC Press
Taylor & Francis Group

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Preface

Processing Motor Vehicles Involved in Violent Crimes developed out of my personal challenges and experiences as a crime scene investigator with the Houston Police Department. After working in general crime scene investigations for 15-plus years, I moved into a position at our department's vehicle examination facility. Our facility processes hundreds of cars every year, and I found the new assignment rewarding, but quite intimidating at first. Believe it or not, there is a learning curve in processing vehicles that is different from working crime scenes in the field. Vehicles offer unique settings for all kinds of criminal activity, and learning how to work through a vehicle so that all potential evidence is located, documented, and recovered in as pristine a condition as possible is something that does not just develop immediately. It takes some special skills and knowledge as well as a great deal of patience to process a vehicle successfully. This book's goal is to give investigators those knowledge and skill sets.

Processing vehicles is unique from the typical crime scenes found in the field and it takes time to develop a kinship with vehicles and to know where exactly evidence can be found hiding. Items from hidden vehicle identification numbers (VINs) to fired bullets that have burrowed deep inside a vehicle can be a challenge to locate, even for seasoned investigators. Searching for these items and other forms of evidence on a motor vehicle involved in a violent crime requires a special sort of deliberate and meticulous approach to the vehicle's processing. Readers will find information and tips toward finding these small and elusive pieces of evidence. Investigators who process vehicles on a regular basis will develop a system or pattern to their work and that pattern is what will make an investigator's body of work much more proficient, as well as efficient. *Processing Motor Vehicles Involved in Violent Crimes* will provide investigators with the tools to develop their own effective manner in which to document and process vehicles.

A solid foundation toward the efficient processing of vehicles begins with solid preparation. The documentation of vehicles begins before the first photograph is ever taken. The proper documentation and tracking of a vehicle in and through a vehicle examination facility is vital to ensure that a legal examination and search for evidence are achieved. The largest and arguably the most important aspect of a crime scene investigator's duty is the documentation of the vehicle. Documentation includes photographing, measuring, diagraming, note-taking, and completing the written report. Consequently, documentation is another theme that runs throughout this book. Readers are provided with some ideas to help with all these tasks, from the moment a vehicle enters an examination facility to when it leaves the facility. Everything from tracking vehicles through the facility to the tracking of fired bullets through a vehicle is presented here. Some ideas may be refreshing reminders to old-school investigators, while other ideas will inspire the new generation of investigators in how they approach a motor vehicle's examination.

As mentioned above, documentation of crime scenes is one of the primary tasks of criminal investigators. More specifically, photography is a major component of this documentation process. Anyone with a camera phone can take a photograph in perfect lighting, with the subject sitting out in the open and already positioned for the best possible composition. However, vehicles offer numerous photographic challenges. Another goal of this book is to help give crime scene photographers the skills necessary to record those same beautiful photographs in the adverse conditions created by the tight confines of a motor vehicle. The greatest tool a photographer has is the brain and being able to operate one's camera in the Manual Mode is a tremendous skill that each investigator should master. Cameras cannot be relied upon to calculate exposures in every situation. Furthermore, cameras are not capable of composing quality photographs. This skill is completely dependent upon the investigator. As a result, photographers must take control of their photographic endeavors, identify the challenges, design a plan to capture true and accurate images, and then execute that plan. Photography is a major component of the documentation process.

Processing Vehicles Involved in Violent Crimes discusses numerous techniques to complete the quality documentation and examination of vehicles and investigatory methods that can help investigators at all levels of capability and resources. Tasks such as searching for semen using alternate light sources and calculating the impact angles of fired bullets and bloodstains will be addressed. Even if one is not an expert in ballistics or bloodstain pattern analysis, they can benefit from this work, because it addresses these topics from a basic understanding, which all begins with using the proper terminology in written reports and recognition of the fundamental elements of crime scene investigations. In the end, I hope that this book will provide vehicle examiners with the knowledge and skills necessary to fully document and process vehicles for all types of physical evidence. Quality investigative efforts do not just happen. They must be planned and legally executed so that any recovered evidence is admissible in court. I am confident that readers will find *Processing Vehicles Involved in Violent Crimes for Forensic Evidence* helpful in achieving this goal, as well as their individual investigative goals.

Christopher D. Duncan

Acknowledgments

Crime scene investigators who specialize in the processing of motor vehicles require a purposeful and relentless personality. Motor vehicles offer numerous challenges to the crime scene investigator or forensic technician and a couple of the best vehicle examiners I know are Houston Police Officers D.C. Lambright (retired) and Alton Holmes. D.C. and Alton preceded me working in our department's vehicle processing facility and I only hope that my quality of work was up to the high standards they set. D.C. had a nose for evidence and could find a fired bullet burrowed deep inside any vehicle. Alton was and is a tremendous photographer and his photographic documentation of vehicles always provided a clear story of what happened to or within any motor vehicle.

Back in 1987, I graduated from George Mason University and had planned to become a history or government teacher with a local school district in Virginia. However, my career path took a detour when the last course I needed to gain my teaching certificate was canceled. Consequently, I started looking at other career fields and applied to the Alexandria Sheriff's Department and joined them in late 1987 as a deputy sheriff. After spending 29 years in law enforcement with the Alexandria Sheriff's Office (Virginia) and the Houston Police Department (Texas), I decided to retire and return to my original choice of career, teaching. Although I taught adult learners across the country in a variety of law enforcement and crime scene investigative topics, I wished to share my knowledge with the next generation of law enforcement officers and criminal investigators. As a result, I began exploring my secondary education teaching options.

I have known Rebecca Schultz for a number of years, having gone to Sunday School with her and her husband James. While still working as a crime scene investigator, I was honored when Rebecca asked me to be a guest presenter at one of her school district's Forensic Symposiums. This opportunity provided a glimpse of secondary education and specifically at the successful criminal justice programs being offered in the Klein Independent School District. Upon leaving the police department, I was fortunate to find out that there was an opening for a criminal justice teacher at Rebecca's school, Klein Collins High School. The administration at Klein Collins is led by Principal Randy Kirk, and he offered me a teaching position. Rebecca nursed me through a tough first year trying to get over the steep learning curve. There is a great difference between teaching teenagers with raging hormones and crawling through a blood-soaked vehicle trying to find a fired bullet. Ultimately, I am truly blessed to work with the greatest team of criminal justice teachers anywhere. Besides Rebecca, I joined David Sparks and Clifton Robinson at Klein Collins, who were already teaching at the school. As our program continues to flourish, because of the rich and authentic talent of these educators, we needed a fifth educator and have been joined by Chantz Humphries. Even though we are one of the smallest high schools in the district, Klein Collins has the largest and most successful criminal justice program. Our kids routinely compete for state championships in the SkillsUSA™ Criminal Justice competitions and are an amazing group of students that give me hope for the future of law enforcement and forensic science.

I could not have finished the composing, editing, and photography involved in this work without the support of my loving wife, Rhonda. She worked just as hard, if not harder, taking care of the home and allowing me to have the time to work on this endeavor while managing a very challenging school year due to COVID-19. My goal for this book is to help police and crime scene investigators recognize the importance of treating motor vehicles as full-fledged crime scenes. Similar to working crime scenes in the field, it is vital for investigators to recover all possible evidence in as pristine a condition as possible. My hope is that this book will help investigators look at a motor vehicle as a whole and help improve their skills to locate, document, recover, and process all possible evidence.

I would like to thank Mark Listewnik at CRC Press/Taylor & Francis for encouraging me to complete my second book for CRC/T&F. After *Advanced Crime Scene Photography*, I was fairly certain I would not write another book. It is a daunting task, to say the least, but I am happy that I was able to write something that I believe will be helpful to others. Every crime scene investigator and/or forensic technician will find their particular style of taking photographs, of spinning a fingerprint brush, and for documenting the paths of fired bullets through a vehicle. There is not just one absolute way of completing these and other common investigative tasks asked of vehicle examiners. Consequently, through the course of one's career and through training and experience, investigators will find which technique works best and makes the most sense for them. Hopefully, readers will find that *Processing Vehicles Involved in Violent Crimes for Forensic Evidence* will offer some new ideas or insights into the examination of vehicles.

Author

Christopher (Chris) D. Duncan is a retired senior police officer with the Houston Police Department. Duncan spent the majority of his career assigned to the Homicide Division, Crime Scene Unit, spending 19 years processing a vast variety of crime scenes. In addition to his time with the homicide division, Duncan was assigned to patrol duties, including spending 2 years as a Gang Task Force Officer. Prior to joining the Houston Police Department, Duncan spent 5 years with the Alexandria Sheriff's Department. Duncan graduated from George Mason University with a BA in history in 1987. In 2007, he earned his MA in criminology from the University of Houston–Clear Lake. Duncan believes training and education are lifelong endeavors and this concept is especially true in the field of law enforcement. During his law enforcement career and outside of his general police training, Duncan attended over 1500 hours of specialized training specific to the documentation, collection, and processing of physical evidence. One of Duncan's more memorable training experiences occurred at the National Forensic Academy (Knoxville, Tennessee), which he attended and graduated from in 2003.

While Duncan was a crime scene investigator, he was recognized as a "Distinguished Member" of the International Association for Identification (IAI), which is the premier organization of crime scene investigation specialists. He was board-certified by the IAI as a senior crime scene analyst, a bloodstain pattern analyst, and as a forensic photographer. During his time with the IAI, Duncan served on the board of directors and several committees, including the IAI's Editorial Review Committee for the *Journal of Forensic Identification*, and the Science and Practices Committee for Bloodstain Pattern Analysis and Forensic Photography. Duncan was also a member of the Chesapeake Bay and Texas Divisions of the IAI, as well as the International Association of Bloodstain Pattern Analysts (IABPA).

Duncan has authored the CRC Press book, *Advanced Crime Scene Photography*. The book has been quite successful, and the second edition was published in 2015. He has written numerous articles, mostly on photography, for the IAI, IABPA, and several of the state IAI organizations. In addition, Duncan has taught at numerous IAI educational conferences and at police and sheriff academies across the country.

Duncan believes in education, and upon retiring from the Houston Police Department, he joined the Klein Independent School District and currently works as a criminal justice teacher at Klein Collins High School (Klein, Texas). Teaching high school students is much different than educating adult learners, but being able to bring the experiences of working crime scenes for a large metropolitan jurisdiction to the next generation of law enforcement officers and criminal investigators is a rewarding opportunity. Duncan looks forward to this opportunity to seeing what the future holds.

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Introduction to Processing Vehicles Involved in Violent Crimes

1

Crime scenes come in all shapes and sizes. They involve any number of variables, including the number of involved parties, the varying amounts and types of evidence, and the variety of environments where crimes can occur. These variables do not change just because the environment centers solely around a motor vehicle. In fact, motor vehicles, of all types, are full-fledged crime scenes in themselves, and they should be treated as such by crime scene investigators and forensic practitioners. Any single piece of evidence that can be found at a typical crime scene can be found on or in a motor vehicle. In addition, vehicles are the most common form of transportation to and from the scenes of criminal acts. Therefore, even if the vehicle is not directly involved with a criminal offense, it still may possess evidence related to that criminal act. As a result, the processing of all vehicles related to criminal investigations should be taken seriously and with an eye toward a detailed examination of said vehicle.

Automobiles offer a variety of challenges or variables to the forensic examiner that a crime scene investigator in the field may not have to routinely deal with. One of the more major variables involves the general construction of a motor vehicle. Even large motor vehicles are compact by design, because the manufacturers put as many features into the vehicle's construction as possible, causing all vehicles to generally possess tight confines. Furthermore, motor vehicles have natural contours, crevices, and compartments that can be difficult to reach into or gain access to, whether it be a hand, flashlight, or camera lens. Motor vehicles are also designed to move, which makes them a challenge to find or capture immediately after a crime has occurred. This freedom of movement provides the opportunity for suspects to clean, wipe, or remove evidence from motor vehicles. The sooner a vehicle is recovered the better, but those quick vehicle recoveries do not always happen. Like crime scenes found in the field, vehicles come in all shapes and sizes. Small vehicles can be difficult to physically maneuver around during the vehicle's examination and evidence collection. Although larger vehicles may be more spacious, they have more areas to hide evidence and may even have secret or clandestine compartments built into the vehicle.

Gaining legal access to vehicles is no different than dealing with crime scenes. Law enforcement officers have a little more freedom to conduct warrantless searches of vehicles in the field, but investigators must remember that once a vehicle is secured inside a vehicle processing facility, then the exceptions to the U.S. Constitution's Fourth Amendment's warrant requirement are terminated and investigators must obtain the vehicle owner's consent or follow through with a court-issued search warrant. Gaining physical access to motor vehicles can also be difficult. Automobiles are routinely equipped with anti-theft devices, alarms, and other features that make them a challenge to enter when locked, especially without causing unnecessary damage. Alarms, kill switches, and the like just offer another challenge to investigators attempting to process a vehicle for evidence. Obviously, these variables and challenges are not the only impediments to investigators working on motor vehicles. Difficulties and challenges that crime scene investigators will face are

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discussed throughout this book, as well as insights into the way one looks at, evaluates, and processes motor vehicles for physical evidence.

Every crime scene is different in some aspect, whether it is found in the field or in a vehicle. As a result, anything found in the field can also be found contained within or on a motor vehicle. An automobile is simply a crime scene on wheels. This concept is a theme that will be repeated. The repetition is necessary because some investigators may incorrectly view vehicles as just a checkmark on some arbitrary investigator's "to-do list." This minimalizing attitude is inconsistent with best practices or a productive work ethic when processing automobiles used in a crime, but especially in violent crimes. Suspects routinely use vehicles to facilitate their crimes. Even if the vehicle is not directly involved in the actual criminal act, it can still possess evidence from the crime. Furthermore, processing a suspect's vehicle can assist in identifying passengers who may eventually turn into suspects during an investigation. In fact, the processing of a vehicle may end up being for the sole purpose of developing a list of potential suspects by identifying who had access to a vehicle or whose fingerprints or DNA (deoxyribonucleic acid) were found on a vehicle.

Most investigators and evidence processors have heard of the evidence linkage triangle (Figure 1.1). Physical evidence creates the links in the evidence linkage triangle and is what evidence technicians are striving to locate, document, and process. The key to any investigation is locating and identifying these evidentiary links between the crime scene, the complainant (victim), and the suspect. This link is made through the physical evidence that must be properly documented, handled, and stored or processed so that it is admissible in a court of law. These connective links between a suspect, victim, and crime scene

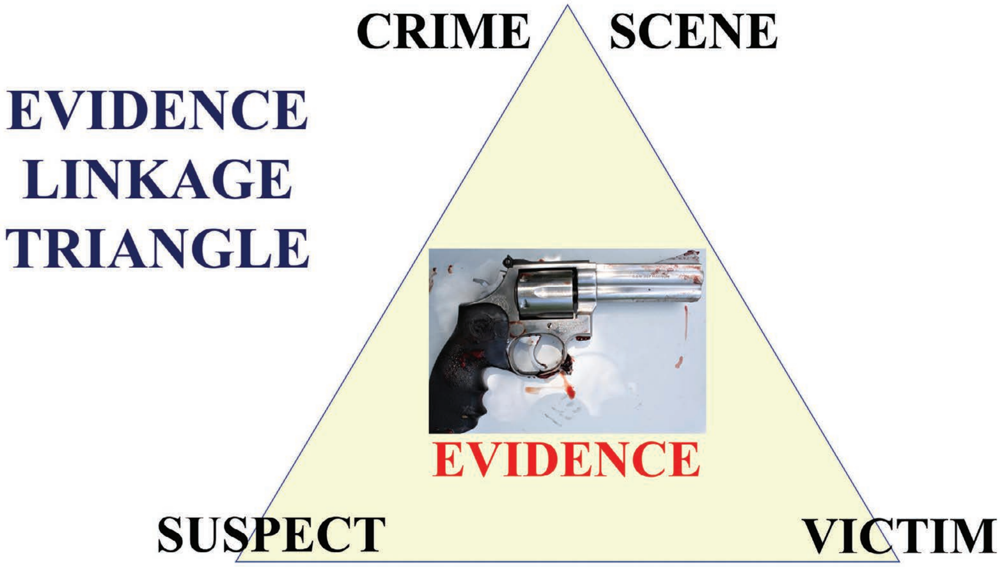

Figure 1.1 The evidence linkage triangle illustrates the crime scene investigator's goal of finding physical evidence that will link the suspect or victim to the crime scene or to each other. Vehicles are often used to transport suspects and victims to and from the scenes of criminality, and therefore, they potentially possess items of physical evidence that can establish a connection between the victim, suspect, and the motor vehicle.

were embodied by Edmond Locard with his “Principle of Exchange.” This Principle of Exchange states that “Every Contact Leaves a Trace.” This concept has become the guiding precept for all crime scene investigators. The Principle of Exchange means that when any two objects come into contact, there is a transfer of matter between the two objects. This transfer or “exchange” of the matter is what the crime scene investigator is searching for in order to make that connective link between the suspect, victim, and/or the crime scene.

Because the automobile is often a key piece of evidence that provides the link between the crime scene, the victim, and/or the suspect, the importance of processing a vehicle for those tangible pieces of evidence is vitally important. The investigator is tasked with establishing or finding the “matter” exchanged between the two or three corners of the evidence linkage triangle. This matter is most often found in the form of fingerprints and DNA. However, evidence can literally be any tangible object that one may possibly think of. Because automobiles are frequently used in some fashion or manner in the commission of a crime, they are oftentimes a great source of valuable evidence. Even beyond the standard fingerprint and DNA identification of passengers, vehicles may be found to possess tools of the crime, stolen property, and numerous other items of physical evidence. The myriad of possibilities regarding potential evidence that can be found inside a motor vehicle illustrates the value vehicles have to many criminal investigations. Consequently, it is imperative that vehicles are processed just as thoroughly and meticulously as any other crime scene would be and possibly even more so because the evidence used to identify a vehicle’s occupant will likely be very small and unseen to the naked eye. Crime scenes are often littered with an abundance of visible evidence, but identifying a vehicle’s occupants will generally come down to the unseen evidence, such as DNA and fingerprint evidence. Therefore, attention to detail and a commitment to the vehicle’s examination is a necessity.

Before an investigator can begin a vehicle’s examination, they must have the resources to complete the job. Examinations are more effectively accomplished in the controlled environment of a vehicle examination facility. Having a quality workspace can make the examination of any vehicle much easier. In addition, it gives the investigator the freedom to work without any time constraints on them. When processing vehicles in the field, there always seems to be a push, even if unsaid, to hurry the examination along. Having vehicles moved from the field to a processing facility eliminates any time concerns. This book will address the tools and equipment one might find useful while working in such a vehicle examination facility. In addition, the general operation and the tracking of vehicles through the facility will be discussed in the chapters that follow. A well-equipped vehicle examination facility can be invaluable to all kinds of investigations, everything from auto theft to homicide and vehicular crashes to sexual assaults. *Processing Motor Vehicles Involved in Violent Crimes* will address all these investigations and discuss the search for, documentation of, and the processing of evidence specific to the different types of crimes an examiner may encounter.

Investigators will process many vehicles belonging to victims, but they will also have to deal with suspect vehicles. In addition, suspects do not always use their own vehicles during the commission of a crime, they have been known to steal vehicles for the sole purpose of furthering the commission of another criminal offense. Consequently, not all stolen vehicles are just juveniles going for a “joy-ride.” These stolen vehicles are used to commit numerous other, more serious, offenses, including burglaries, robberies, and murders. For example, one of the more popular crimes currently being committed is “smash and grab” burglaries, where the suspect(s) steal a pair of vehicles, driving one into a business, breaching the business' exterior, and using the second vehicle to haul away the stolen merchandise. The first vehicle can become so damaged by its impact with the building that a second vehicle is needed to make the getaway. Larger and more rugged pick-up trucks are typically used to create the opening into a business' exterior wall, while minivans with sliding side doors are often preferred as getaway vehicles [Figure 1.2(a) and (b)].

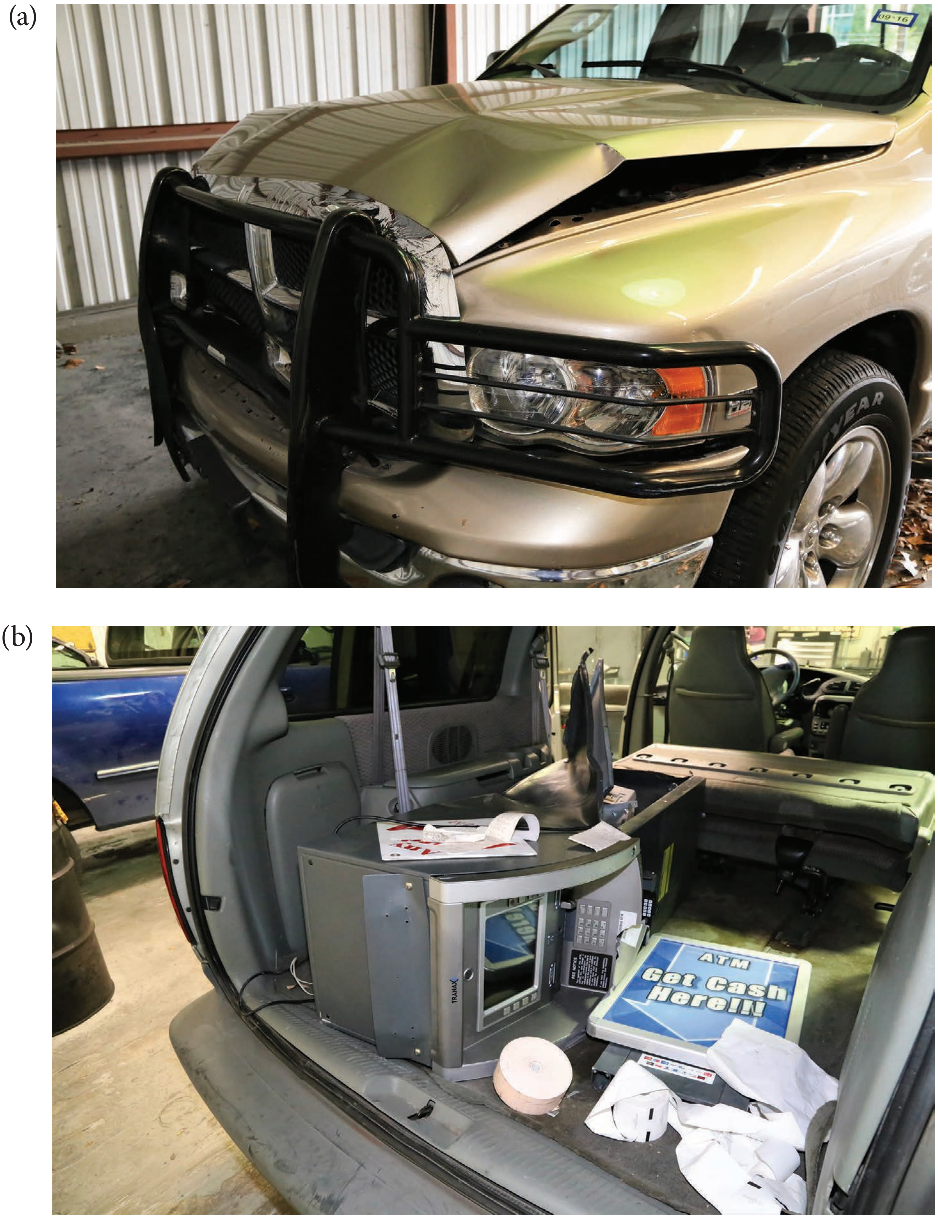

Figure 1.2 (a) Large size pick-up trucks are popular vehicles to steal and then use in smash and grab burglaries. Because these vehicles are often disabled in the furtherance of the crime, a second stolen vehicle is often used to carry away the ill-gotten gains. (b) The getaway vehicle is frequently a minivan that is equipped with sliding side doors. The sliding doors offer an easier way to load the stolen goods into the van.

Suspects use stolen vehicles to further their criminal endeavors more frequently during planned and/or organized criminal acts. Other crimes are more spontaneous or disorganized. Crimes that occur in the heat of the moment or as the result of a perceived opportunity to commit and get away with a crime often offer a greater likelihood for investigators to locate evidence within a vehicle. This is understandable because there was no planning that took place prior to the crime's commission. Although suspects may attempt to conceal evidence, those actions are more likely to be done hastily and, therefore, less thoroughly. Unorganized crimes include a variety of assaultive crimes and other crimes of opportunity, such as robberies and assaults [Figure 1.3(a) and (b)]. These types of crimes frequently involve the shedding of blood. Sometimes, the blood is clearly visible to the naked eye, and other times, the blood has been cleaned up by the suspects and, therefore, requires

(a)

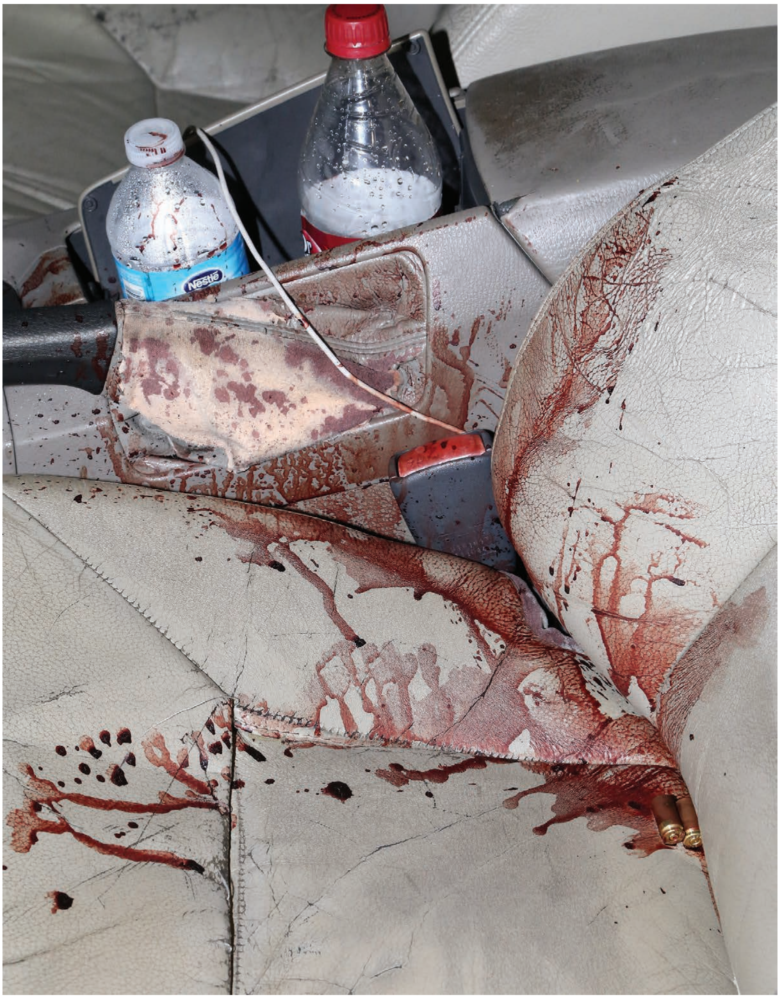

Figure 1.3 Unorganized crimes, such as assaults, routinely result in bloodshed. (a) Sometimes blood is easily visible, while at other times.

(b)

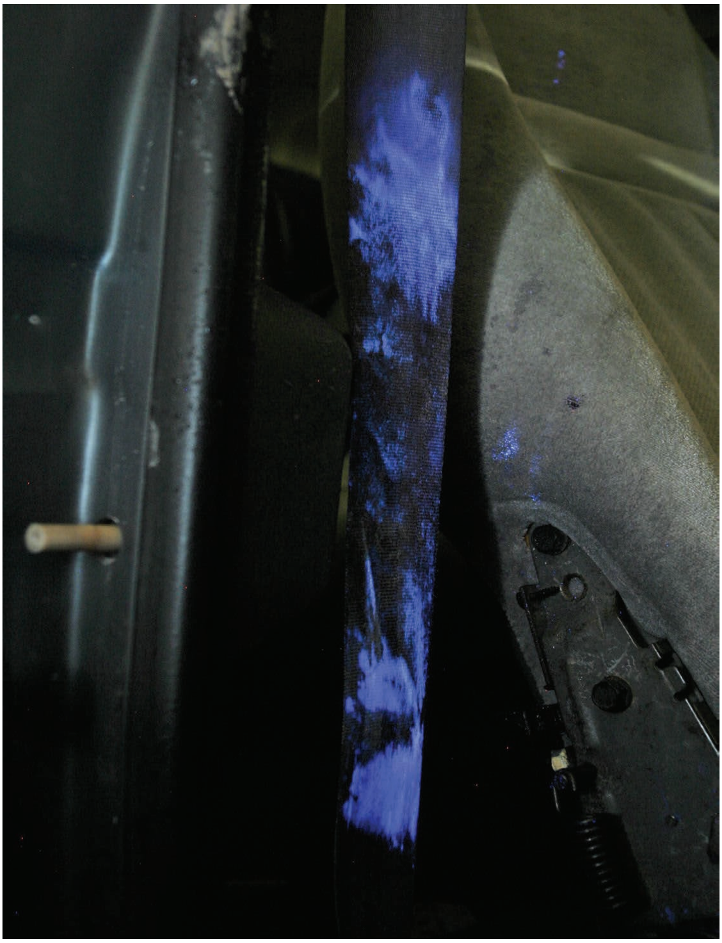

Figure 1.3 (Continued) (b) Bloodstains have been cleaned and their detection requires chemical enhancement, like luminol or Bluestar®.

the use of chemical enhancements to visualize the blood. Consequently, the proper search, documentation, and collection of bloodstains are vital to any criminal investigation, and as such, bloodstain documentation will be discussed in detail within this body of work. Anyone routinely working on vehicles should become extremely comfortable and proficient with investigating bloodletting events.

Beyond investigations involving organized and disorganized crimes, investigators may become involved in vehicle crashes, accidents, or assaults. Dealing with these types of incidents can become problematic because of the condition the vehicle may be in after a serious crash (Figure 1.4). Investigators may be called upon to recover paint transfers between vehicles, as well as to identify who was driving a vehicle at the time of a crash. In vehicle-pedestrian accidents, vehicles that have been repaired or cleaned after the accident can make the search for evidence more difficult. For this reason, investigators must be extremely diligent and meticulous in their examinations.

This book will cover how to conduct a legal and productive search, how to document a vehicle through measurements, photographs, and quality note-taking, as well as a host of evidence search and collection techniques. The complete documentation of a vehicle is the

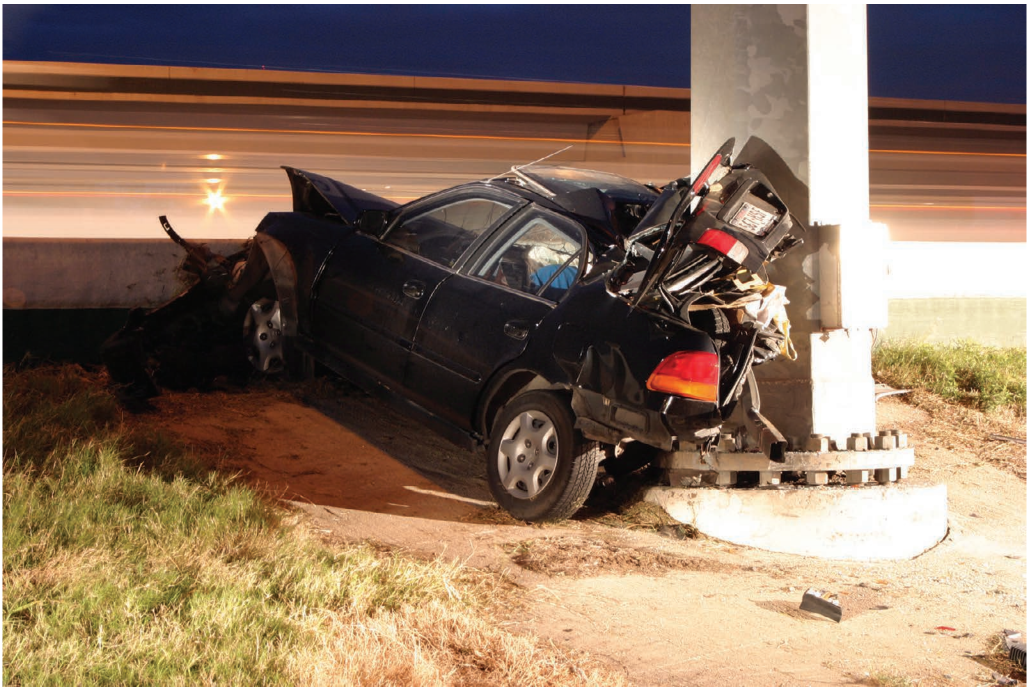

Figure 1.4 Investigators may have to deal with vehicles that have been severely damaged due to a crash. Regardless of the vehicle's condition, investigators will still need to process these vehicle for evidence.

most challenging part of processing an automobile used in violent crimes or any crime for that matter. The documentation of vehicles is critical to any criminal investigation involving automobiles and requires specialized knowledge in proper note-taking, photography, and the measuring and diagramming of vehicles. For example, using proper terminology in ballistic and bloodstain case reports is vital so that investigators who are the readers of any police report have a clear and definitive understanding of what was found or determined by a vehicle's examination. The writing of clear reports and the creating of valuable vehicle diagrams will be addressed and cannot be overvalued.

Once a crime scene investigator or evidence technician has been assigned a motor vehicle to process, regardless of the exact nature of the crime, the investigator must complete some background work before diving directly into the processing of the vehicle. First and foremost, the investigator needs to establish the legal authority to search the automobile for evidence. Most often, this will involve a "Consent to Search" for the vehicle. On other occasions, it may require a search warrant. Whichever path the investigator takes, conducting an "unreasonable search" in violation of the United States Constitution's Fourth Amendment will only result in any recovered evidence being excluded from testimony during a court trial. The crime scene investigator should also gather information related to the crime and what is known about the crime from the primary case investigator. This information will give the evidence processor an idea of what kinds of evidence they might be looking for, especially small or latent pieces of potential evidence. Good communication between all investigators, evidence technicians, and laboratory personnel will help everyone from overlooking something that might turn out to be quite valuable to the overall investigation. The crime scene investigator and the case investigator, assuming they are two different persons, and the laboratory personnel need to be on the same page regarding the investigation so that nothing is left behind or left to chance.

Once the crime scene investigator has an idea of what is needed from the vehicle, they can concentrate on formulating a plan of attack for processing the vehicle for evidence. Every crime scene, including those involving automobiles, begins with a thorough documentation of the vehicle, including the recording of quality handwritten notes and evidentiary photographs. Handwritten notes need to be legible, descriptive, and complete. Completeness and thoroughness should be a guiding principle for all crime scene investigators. Taking shortcuts and cutting corners is never acceptable. Photographing a motor vehicle follows the same logic. The value of completeness is never outweighed by expediency. Investigators can "work smarter, not harder," and they may be efficient in their work, but efficiency is not at the expense of completing comprehensive documentation of a vehicle. Photographing vehicles can be a challenge and, therefore, is a large component of this book. Both the basic camera operation and image compositions will be discussed, as well as discussions on how to photograph difficult subjects such as laser trajectories and photographing luminol reactions. One recommendation for all crime scene investigators is that they should routinely and critically review their photographic body of work, make note of any deficiencies or poor photographs and seek to improve those photographic efforts during the next criminal investigation. It is much better to self-identify and correct deficiencies before some defense attorney points them out to a jury.

After the vehicle has been thoroughly documented, which is actually a constant and ongoing activity throughout a vehicle's processing, investigators can set out and search the vehicle for evidence. Knowing what to look for and where to look are important skills to develop. For example, knowing how to locate trace amounts of blood or semen, track the path of fired projectiles, and where to find hidden vehicle identification numbers (VINs) on an automobile's frame are just some of the tasks the vehicle examiner will be required to complete at some point in their career. Other skills that are commonly associated with vehicle examinations include the processing and collecting of fingerprints and DNA evidence. These two tasks are so common that before long, investigators will become quite adept in processing vehicles for these types of evidence. These skills and others will be discussed throughout this body of work.

One is not done being meticulous once evidence is found. Investigators must strive to maintain the chain of custody and carefully document and package each recovered item for submission into evidence. One key to the successful collection of evidence is to clearly identify all recovered evidence and identify exactly where in the vehicle the item was recovered from. Recording quality notes and writing effective reports will assist investigators to ensure that all evidence reaches the courtroom and is admissible. Everything from clearly marking each and every level of the evidence's packaging to expertly documenting within an investigator's written report is the key to guaranteeing an object's admissibility in court.

In the end, an investigator's mindset and skill will determine how effectively a vehicle is processed. As long as each individual automobile is treated as if it is the most important aspect of the case, then the investigator's approach to the vehicle's processing should be on solid ground. Treating each vehicle as an independent assignment and not getting caught up with one's own caseload or other responsibilities is a great first step toward processing any crime scene. With a focused attitude and a dedication to one's craft, crime scene investigators cannot help but be successful. In addition, investigators should keep an eye toward the meticulous and complete processing of vehicles and never settle for having done “enough.” The job is not complete until all investigative questions have been answered or at the very least attempted to find an answer. Not every investigative question may be answered, but one must try. It is the hope that this book helps forensic practitioners and vehicle examiners find that focus and assists them in providing the complete processing to any type of motor vehicle they may encounter during their career.

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Vehicle Examination Facility and Processing Equipment

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Vehicles involved in violent crimes can be processed in the field and frequently are processed in the field. However, the vehicles processed in the field are generally less serious crimes, like burglary of a motor vehicle or unauthorized use of a motor vehicle (auto theft). This is not to say that misdemeanor crimes and less serious offenses should not be investigated, but because the processing of these vehicles does not necessarily require the special skills of a trained evidence or forensic technician, then they can be processed in the field by a patrol officer. Vehicles that are simply damaged or taken for a "joy ride" do not necessarily need a bloodstain pattern expert to evaluate bloodstains found on the car or need a bullet trajectory analysis completed. Auto theft and burglary cases are generally limited to the collection of latent prints and possibly DNA swabbings. More advanced processing techniques are typically required in more serious crimes and are better processed in the controlled environment of a vehicle examination facility.

The controlled environment of a vehicle examination facility offers many advantages over a field investigation. The primary benefit of working in a controlled environment and weaves through all the different advantages is *time*. Time comes in a variety of beneficial factors, including the time to ensure a legal search is obtained, the time to develop the context in how the vehicle was involved in the crime, and the time to properly process a vehicle for evidence. Some may have heard the motto, "There should be no rush to judgment." The same philosophy goes for the collection of evidence. A thorough and meticulous examination of a vehicle for evidence takes time. Obviously, not every car will have the benefit of an examination conducted in a vehicle examination facility. These vehicles are processed in the field, and quality evidence is still gathered. Therefore, just because one does not have access to a proper processing facility, does not alleviate the investigator of their responsibility to process a vehicle for evidence to their utmost ability.

Large city and county law enforcement agencies are more likely to have a garage facility of some sort that can be used to process vehicles for evidence. It will be the smaller agencies that are likely to not have the general need for a vehicle processing facility. In those cases, the agencies are bound to have a garage facility of some sort in order to work on patrol vehicles and keep them running. In a pinch, investigators could request to use one of the police vehicle bays as a resource. One would probably not want to store a vehicle in such a facility over time, like when waiting for a search warrant to be signed by a judge, but it is certainly acceptable to examine a vehicle in one of these facilities. In addition, most police garages are equipped with car lifts and enough tools to make a detailed examination easier. The evidence technician simply must provide the crime scene investigation-specific equipment to the garage facility.

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Vehicle Examination Facilities

Not many investigators will get the opportunity to design and build a vehicle examination facility to their specific desires. However, investigators do typically get a yearly budget to work with and can build out existing facilities over time and make them more useful and the work more efficient. Unfortunately, when it comes to police work and criminal investigations, money and resources are always long on demand and short on supply. Sometimes thinking outside the box and finding alternatives to expensive products can assist evidence technicians who are short on funding. Beyond doing research and finding alternatives to costly supplies and tools, one will simply have to prioritize their needs and hope that during the next fiscal year, an investigator can obtain the next item on their wish list.

It is recommended that vehicle examination facilities be built close to existing agency garage and fleet-maintenance facilities for a number of reasons. The different duties that are completed between a garage where vehicle repairs are made and where vehicles are processed is much closer than one may initially believe. Vehicle repair facilities are typically putting vehicles back together, while vehicle examination facilities are more often tasked with taking vehicles apart. As a result, when an evidence technician becomes stumped while trying to figure out how a particular vehicle works or how to take a particular piece of the vehicle off without causing extensive damage, then the technician can seek the guidance of one of the nearby mechanics for help. Car mechanics are a tremendous resource to have when assistance is needed while working on a stubborn vehicle. Fleet repair facilities or impound lots typically have access to forklifts and having a forklift is extremely helpful with moving vehicles around the lot. When a vehicle examination facility is busy, vehicles will have to be moved in and out of the facility, and not every vehicle is drivable. As a result, a forklift is frequently needed to move the vehicles in and out of the garage bays and facility (Figure 2.1).

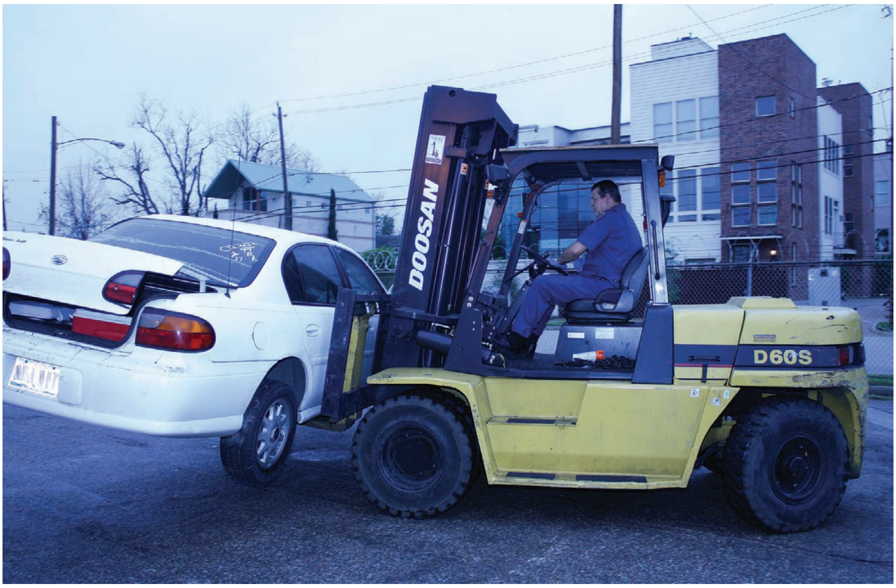

Figure 2.1 A forklift is a godsend when an investigator must move vehicles in and out of their facility. It is especially useful when a vehicle has been damaged beyond the ability to roll freely on its own.

To begin with, a quality facility must be secure. The site must be secure to protect the vehicle's chain of custody and the evidence found on and inside of it. Like any police facility, a quality fence and controlled access gate are required (Figure 2.2). Access to the facility should be limited to law enforcement personnel only but does need a way to allow 24-hour access for the dropping off of vehicles during all hours of the day. How officers and investigators gain access to the facility during the middle of the night can include key locks, combination locks, or electronic locks with key card access. Combination locks are the least secure, since the lock's combination will eventually be possibly shared once too often and shared with the wrong person. The fenced area around the actual garage facility should be large enough to accommodate larger vehicles, not necessarily a semi-tractor trailer truck, but the occasional box truck or school bus. In addition, space will be needed to store vehicles waiting for pick-up by their owners and an overflow parking area for vehicles awaiting processing.

The garage facility itself would benefit by having both indoor garage bays and covered-outdoor garage bays (Figure 2.3). The covered-outdoor garage bays are beneficial when a human body has been decomposing inside of a vehicle over time and that car needs to be processed for evidence. The garage bays should be oversized. The extra height and depth not only allow the facility to handle larger vehicles but also provide space for the investigator to maneuver around the vehicle while processing it. The number of bays needed

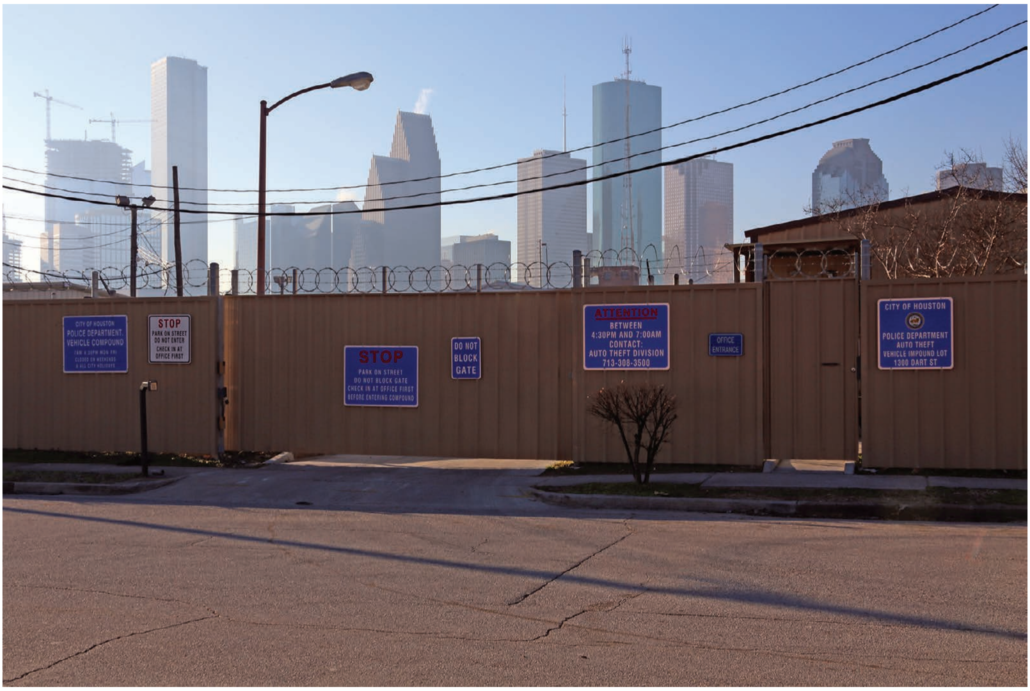
CITY OF HOUSTON
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Figure 2.2 A secure vehicle examination facility is important to maintain the evidence's chain of custody. Having secure fencing around the facility and having controlled access to the property are important components of a safe and secure facility. After-hours access to a closed facility can be garnered through providing officers with keys to the facility or, as is shown in this photograph, having a coded keypad for employees to access the property. The keypad is positioned on the left side of the driveway.

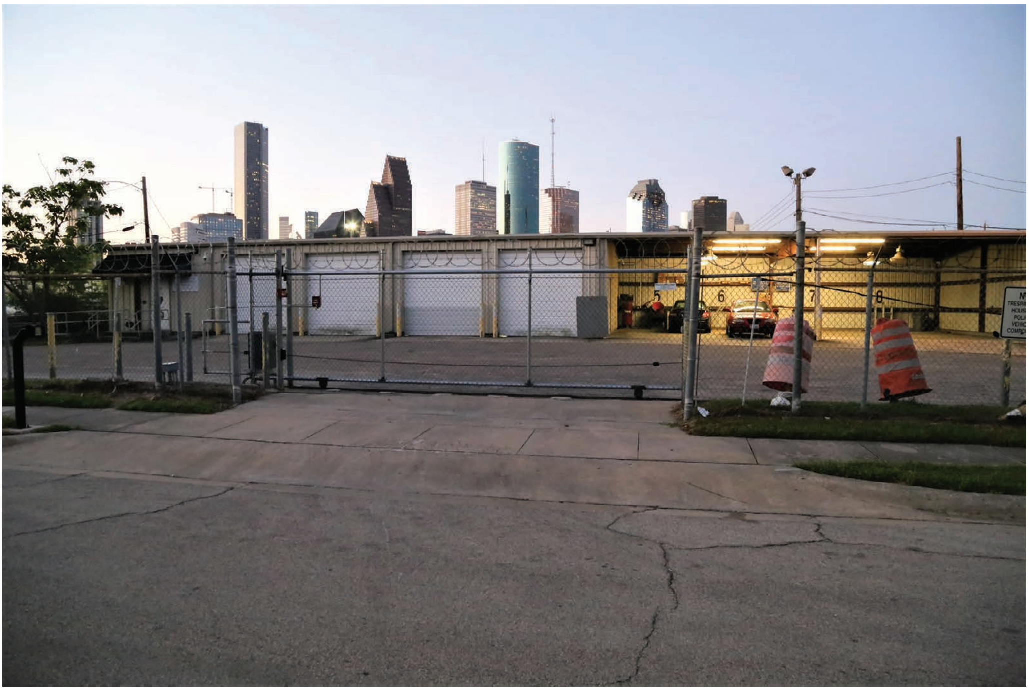

Figure 2.3 Having an indoor and outdoor processing area is recommended for any high-volume facility. There will be vehicles, such as those that once held a decomposing body, that investigators will not want to open up in an enclosed environment.

depends on the size of the law enforcement agency and the number of vehicles they expect to process during the year or at any given time. Smaller agencies may need one or two bays, while larger agencies may need four or five bays for each indoor side and outdoor side. It would be nice if a vehicle examination facility could be planned for future expansion and built to accommodate future needs but that might be asking for a bit too much.

Having indoor facilities to work in is invaluable to crime scene investigators for numerous reasons. Besides the safety and security of an enclosed environment, an indoor facility protects the vehicle and evidence technician from the weather. Working outdoors in the northern latitudes during the winter or in the southern latitudes during the summer is not always a whole lot of fun. Having a protected environment will help protect the evidence as well as the investigators. It should go without saying that the facility should have central air conditioning and heating. However, there is one major warning for those tasked with the garage's maintenance and that is the air filters in both systems must be changed frequently. In addition, the air filters used in the facility should be of the highest quality available. The fine fingerprint powder that will float through the air and be sucked up in the air returns, causing the air filters to become clogged. In turn, the clogged air filters will cause the system to overheat and breakdown. Furthermore, the fine particles of fingerprint powder can pass through an inexpensive filter and get into the actual heater or air conditioning system, causing major mechanical failures. It will not be a good work environment to be working in 100°C temperatures, with 90% humidity, only because an inexpensive air filter was used or was not changed in a timely fashion.

Having flexible and quality lighting is another extremely important aspect of developing a productive vehicle examination facility that will be productive. Light-emitting diode (LED) lights are preferable because they are balanced for white at approximately 6000 K. The color cast by different light sources is not as noticeable to the human eye as it is to the camera and may result in poor investigatory photographs. Incandescent lights and high-pressure sodium lights produce yellow to orange hues, while mercury vapor and fluorescent lights produce blue to green hues in photographic images. Consequently, LED lights are the best choice for investigators. Another benefit of mounting LED lights in the shop is that they do not cast heat down on the investigators as incandescent lights can. In addition to the overhead lights permanently mounted to the garage's ceiling, investigators would benefit from having retractable shop lights hanging over each vehicle bay. The retractable shop lights are protected light housings on retractable extension cords. These lights can be pulled down and used to look into the shadowed recesses of a vehicle.

Beyond the standard facility lights that will illuminate the processing bays, the evidence technicians should have ultraviolet ("black lights") or alternate light sources (ALSs) available. Ultraviolet lights can help investigators locate the presence of semen and other body fluids inside of vehicles. There are expensive ALSs, but investigators can use long-wave ultraviolet lights that are much more inexpensive and can be purchased from the Internet and even from some big-box department stores. The ultraviolet lights come in several forms: incandescent, fluorescent, and LED. The variety of forms allows investigators to mount the correct or similar light source in retractable shop light housings that can be mounted above each vehicle bay. Having an ultraviolet light available by just reaching up for the retractable shop light is advantageous because of its quick and easy access for investigators.

It would be beneficial to have a small office area attached to or as a part of the garage facility. An office area is necessary for doing paperwork, coordinating and meeting with case investigators, and writing reports. This clean area needs to be out of the area where any fingerprinting and other processing efforts are being completed. No matter how neat one is in their fingerprinting efforts, the black powder is going to settle on every exposed surface inside the examination bays. Nothing good can happen when fingerprint powder finds its way into a computer's case and settles across the motherboard. As a result, it is necessary to have an area that is free from the debris, activity, and odors of the garage bays. If this clean area has room for the processing and packaging of evidence, then that too would be extremely beneficial.

It would be beneficial if the office possessed a vehicle management board of some sort. A vehicle management board is a way to conveniently track vehicles in real time, typically on some sort of large dry-erase board. Such a board would include some combination of the following items:

- Date
- Vehicle description (year, color, make, model, vehicle identification number—VIN)
- License plate number
- Concerned investigation division and/or case officer
- Incident or department case number
- Status (pending, ready, complete)
- Location (garage bay number or other location)

One of the major pieces of equipment that is needed in any garage setting is a car lift (Figure 2.4). Car lifts allow investigators to have easy access to the underside of the vehicle, which is not an uncommon necessity. In hit-and-run investigations that involve a pedestrian being run over, the underside of the vehicle needs to be examined for blood, tissue, and clothing fragments. Other situations may include shooting incidents where the fired projectiles struck near the underside of the vehicle or in narcotics investigations and investigators must examine the underside of a vehicle for hidden compartments full of narcotics. A word of warning regarding car lifts, please follow the manufacturer's directions because if the car is not balanced correctly on the lift pads, then the vehicle could flip over onto the ground. Vehicles are not weight balanced from front to back. The weight of the engine causes a severe imbalance between the two ends and could cause a vehicle to topple if the support pads are not placed in the proper position. As a final recommendation, car lifts need to be professionally installed and periodically inspected.

In addition to the car lift, a vehicle examination facility will definitely need some heavy-duty floor jacks and wheel dollies. Vehicles will often be brought into the facility in various states of damage. Some will simply have flat tires, while others could be completely crushed due to a major accident. Vehicles are typically brought to the examination facility via a tow truck or wrecker. The wrecker drivers are not forensic experts and are simply transporting a vehicle from point A to point B, without much thought about how the vehicle is placed into the facility. Consequently, vehicles will sometimes have to be repositioned inside the garage bay and that task is made difficult because of flat tires and other external

(a)

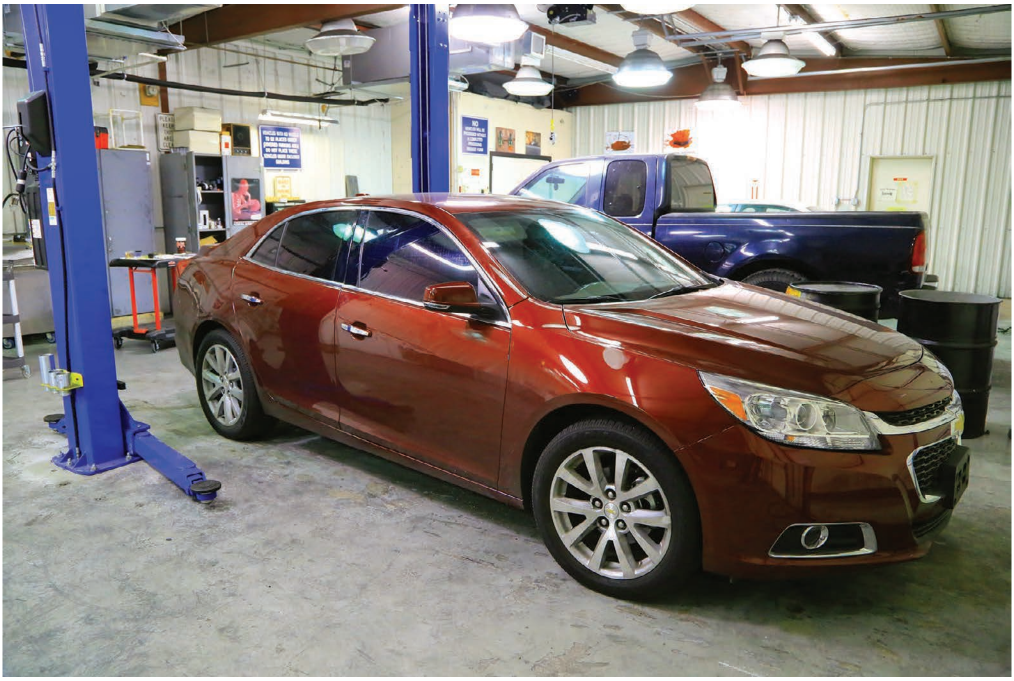

Figure 2.4 (a) A car lift is invaluable to investigators.

(b)

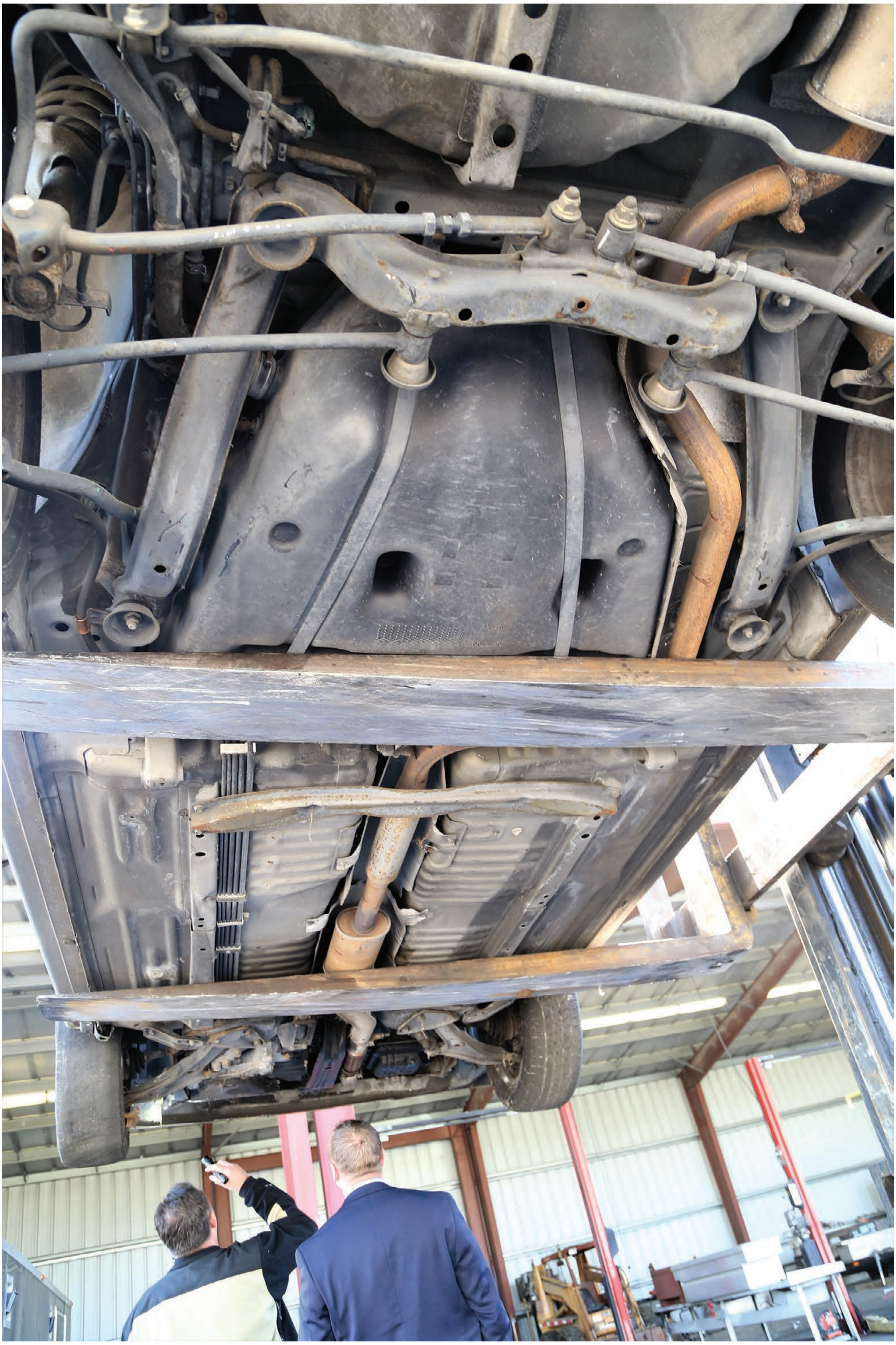

Figure 2.4 (Continued) (b) Examining the undersides of vehicles is a common task during vehicle examinations and being able to safely lift the entire vehicle off the ground is a valuable asset.

damage to the vehicle. Because of the relatively tight quarters, it is easiest to maneuver a vehicle on wheel dollies (Figure 2.5). A hydraulic floor jack is also a necessity. The floor jack can be used to raise a damaged car so that the wheel dollies can be positioned. Floor jacks can also be used to raise a car for a quick inspection or evidence recovery, instead of using the car lift. Because any size vehicle may show up at the garage, a quality 3-ton floor jack is recommended, if not larger. As a side note, investigators should never get underneath a vehicle that is resting solely on a floor jack. If an investigator needs to reach under a vehicle to retrieve evidence or take a picture, the car should be supported on a sturdy pair of jack stands and the wheels that are on the ground should have chocks placed under them to prevent the vehicle from moving. In order to easily slide under vehicles, investigators would benefit from having a "Mechanic's Creeper," which is a padded board with wheels on the bottom. The investigator can lie on the board and slide easily in and out from underneath the vehicle.

Without question, investigators are going to need an assortment of hand tools and even power tools. The hand tools will be very similar to those found in a mechanic's garage. Investigators are going to be digging into every corner and every conceivable crevice of a motor vehicle, and a set of quality tools will be much appreciated by investigators. Evidence technicians will frequently be taking parts off of vehicles in order to reach fired projectiles

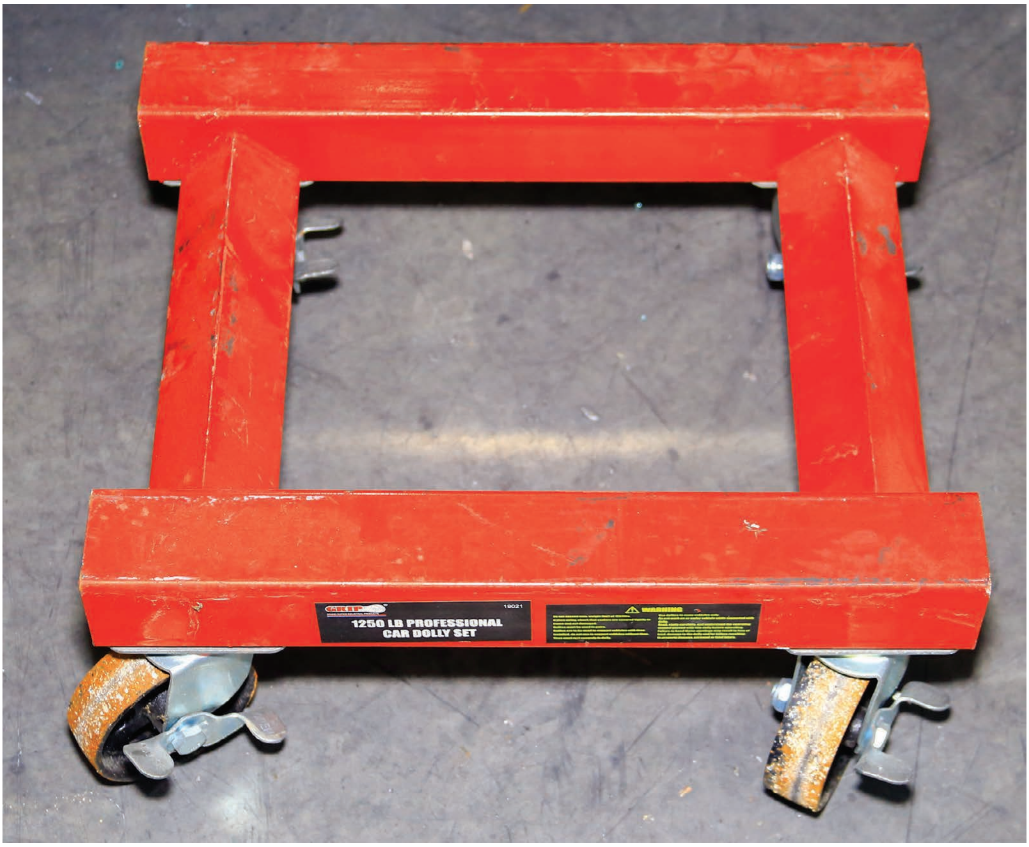

Figure 2.5 Wheel dollies allow for a vehicle to be repositioned or moved around inside a garage, even when the tires are flat or other extensive damage the vehicle may have sustained.

that have lodged themselves behind car doors, inside engine compartments, or underneath wheel wells. Investigators, like car mechanics, will collect a nice assortment of tools over time. However, if an investigator is just starting out, they should have a basic assortment of tools that might include the following:

- An assortment of flathead and Phillips-head screwdrivers
- Wrenches
  - Crescent wrenches
  - Ratchet wrenches
  - Box-end and open-end wrenches
- Pliers and channel-lock pliers
- Hammers and rubber mallets
- Prybars
- Trim removal tools
- Sharp knives and cutting tools

The "trim removal tools" are going to be used frequently when trying to remove fired projectiles from car doors and other internal trim features, which is a very common place to find fired bullets in vehicles that have been shot up (Figure 2.6). Another practical reason to use the trim removal tools is that they cause less damage than a standard screwdriver or pair of pliers would cause. Investigators will naturally damage vehicles during their processing, especially in cases where the vehicle received multiple gunfire impacts. There is no need to compound the victim's troubles by destroying their property and by using the specifically designed tools to disassemble a motor vehicle, then the investigator can possibly save the vehicle's owner some heartache.

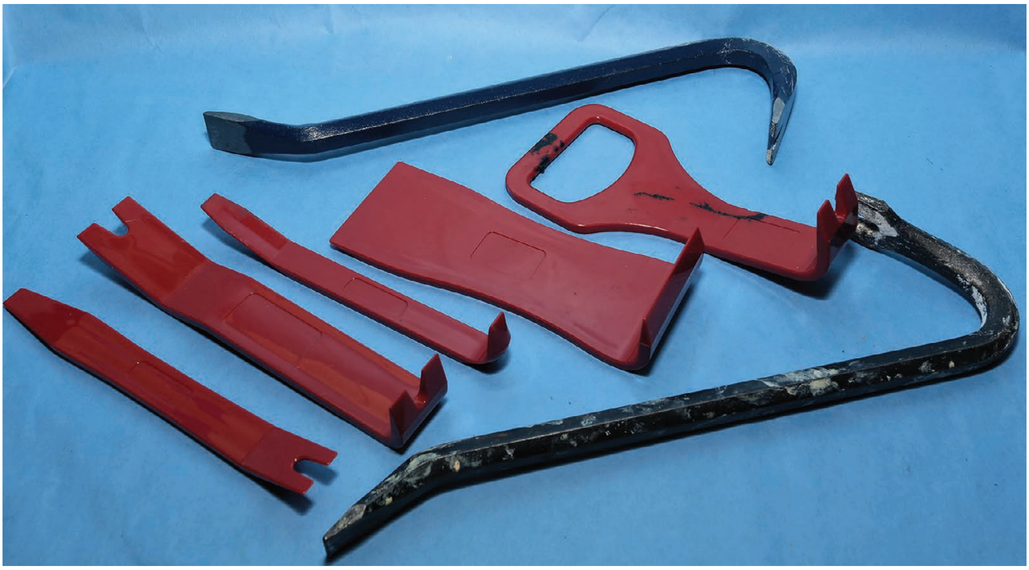

Figure 2.6 Trim removal tools and pry bars make the removal of interior door panels and interior/exterior plastic trim pieces much easier and less damaging than just ripping pieces of trim off the car. Large screwdrivers may also work in a pinch, but the specially designed pry tools are less likely to cause permanent damage to the vehicle.

In addition to a basic collection of hand tools, the investigator's job will be made easier by having a solid air compressor and power tools, such as metal shears or cutters. Cutters come in a variety of styles, from air-powered to electric-powered tools and from metal cutting shears to a variety of saws. Air compressor tools are excellent for working in garages. One will need a large-capacity air compressor, preferably a compressor with a 20-gallon capacity, but better if the size is closer to 80 gallons. Another air tool that would be beneficial is an impact wrench. An impact wrench can help remove stubborn bolts and a wheel's lugs if the wheel needs to be removed from a vehicle. Regarding wheels and tires, an air chuck is also useful. The air chuck is used to pump up tires. While shopping, investigators may pick up an air-blower attachment. An air blower attachment can be used to blow off unwanted material that might be resting on a vehicle or other work surfaces, such as pollen or leftover fingerprint powder. An air blower can also be used to help dry off a vehicle of moisture prior to processing for fingerprint evidence.

On occasion, vehicles will arrive at the garage, and they will come without keys and the doors are locked. As a result, investigators will need a "break-in" or "lockout" kit. Break-in or lockout kits can be easily purchased via Internet retailers. Prior to the days of electronic-locking devices and the multitude of wiring harnesses stored inside of car doors, police officers, wrecker drivers, and criminals would carry "Slim Jims" to break into a locked car. The Slim Jim would slide into the car door by pushing it between the car window and rubber trim. The Slim Jim would pull up the door lock from inside the door's frame. However, one does not want to use Slim Jims any longer, because of all the electronic wiring that is inside the door. These wires are more likely to be pulled out of the window crevice instead of unlocking the door. The break-in kits typically have a variety of tools, but the basic tools are a wedge, an air bladder, and a few differently shaped rods. The wedge is pressed in between the top of a door and the car's roof. The air bladder is nestled into the small gap created by the wedge and is inflated with a hand pump. This creates enough of a gap between the door and the roof's edge that one of the metal rods can be slid inside the car and used to snag the door handle or thumb lock, which opens up the car from the inside. Using a break-in kit is much more preferable than smashing out a car window, even if one does possess a search warrant.

Storage for all the tools, equipment, and processing supplies is also going to be needed. Toolboxes, lockers, and/or closets should be a part of the vehicle examination facility. It may not be so important to keep wrenches clean from the fingerprint powder floating around the facility, but all the other processing equipment needs to be kept separate from the processing area until needed. The facility is also going to need a workstation and maybe two, based on the volume of work anticipated. Workstations should consist of a large table, and it would be helpful if the table had a butcher paper roll dispenser mounted on one edge of the table (Figure 2.7). Butcher paper typically comes in 3-foot-wide rolls. This heavyweight paper is used to protect surfaces and provides a clean surface to package evidence upon. The workstation should also be set up with a basic supply of everyday needs, such as pens, Sharpie® or other permanent markers, packing, and evidence tapes. A second style of workstation is also recommended. This second workstation is one that is on wheels and is used to move along with the investigator as they move around the vehicle during its processing (Figure 2.8). This workstation provides storage and easy access to the investigator's tools.

Another large piece of equipment that is fairly important for the vehicle examination facility to have is a ladder. The ladder is not the collapsible ladder that one would use to

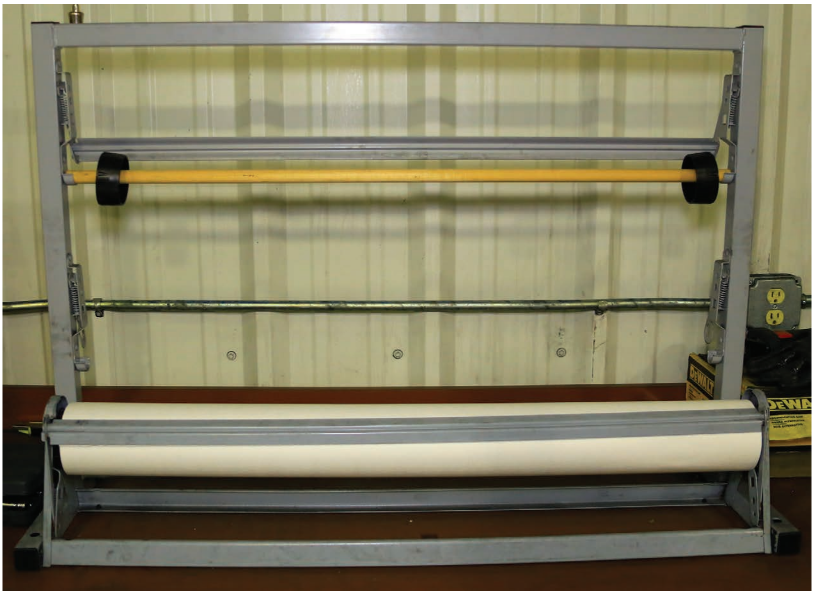

Figure 2.7 Workstations inside of a vehicle examination facility should have a butcher paper dispenser mounted on one side so that a clean surface can be established for the processing and packaging of recovered evidence.

Figure 2.8 Investigators will benefit by having a rolling cart to place their processing equipment on. The cart can be moved around the vehicle during the processing and preventing the investigator from wasting time walking back-and-forth between a fixed storage site and the vehicle.

work on one's roof. Instead, an "Industrial or Warehouse Rolling Ladder" is recommended (Figure 2.9). These "A-Frame" ladders have locking wheels mounted on the base so that the ladder can be easily maneuvered around a vehicle and the wheels can be locked down when someone climbs up the steps. Small size ladders come with three or four steps, but the recommended size would have five or six steps. There will be occasions when evidence technicians will need to process the top of a tall truck or van, and the ladder allows easy access to that part of the vehicle. In addition, photographing the overall condition of the vehicle can often be better done from an elevated position (Figure 2.10).

A recurring theme so far has been how dirty a vehicle examination building can get. The fingerprint powder processing of vehicles is an extremely dirty process. The sheer size of the vehicle is the cause of so much fingerprint powder floating around. Laboratories have "Vent-a-Hood" stations that suck all the loose powder particles away from the examiner. This may work when one is processing a beer bottle or a cell phone, but they are not as useful when fingerprint processing a Ford F-250 King Cab pick-up truck. In addition to the fingerprint powder, vehicles will enter the facility in all kinds of conditions. Everything imaginable will be falling off or dripping from the vehicle. Engine liquids and lubricants will be found dripping onto the garage's floor. Broken glass and other damaged vehicle parts will constantly be raining down onto the facility's floor. Furthermore, the vehicles that come into a processing facility are not always the cleanest form of transportation imaginable, and when processing the interior of a vehicle, the trash that is frequently found piled high inside of the vehicle must be removed so the vehicle can be thoroughly

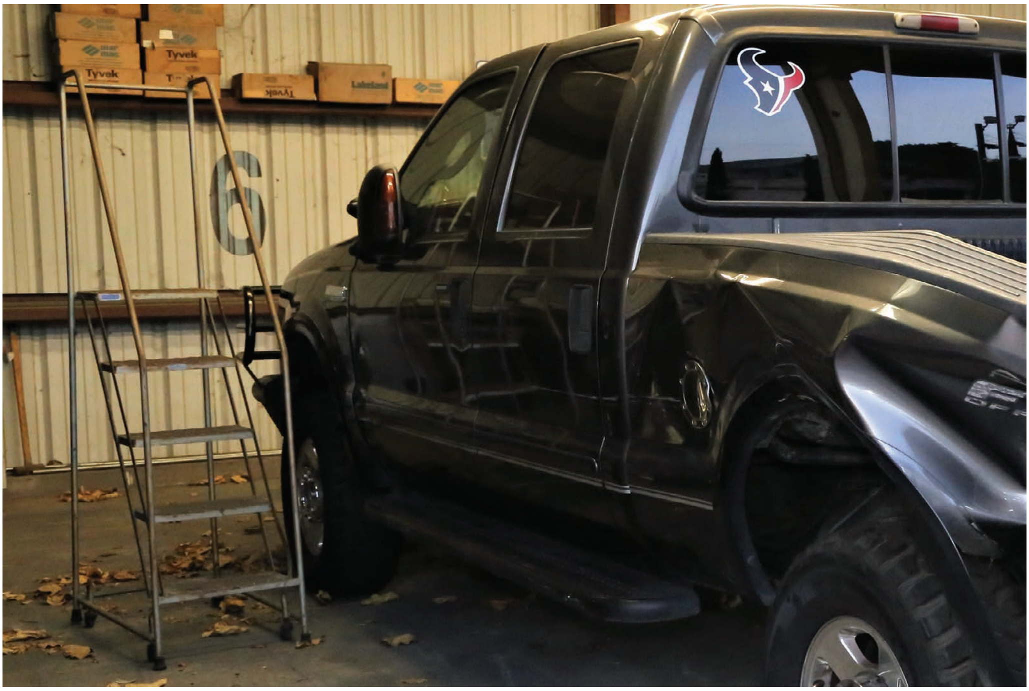

Figure 2.9 An industrial or warehouse rolling ladder helps investigators process the upper areas of tall trucks or vans. These types of ladders come in a variety of sizes. Having a ladder with enough steps to reach the top of a box van or even a tractor-trailer might be of some use on occasion.

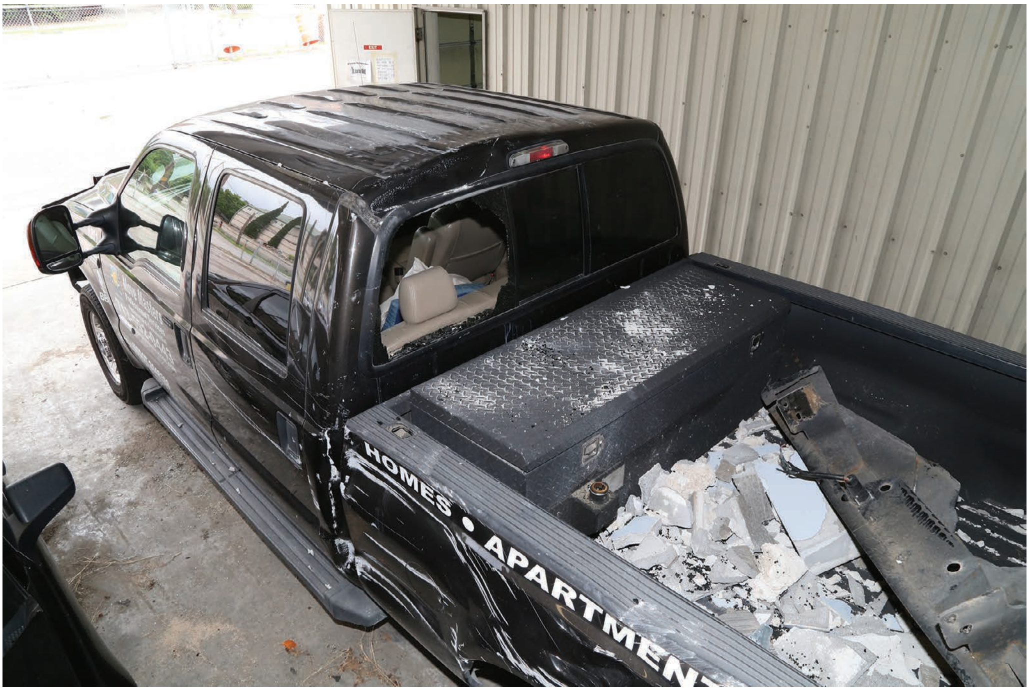

Figure 2.10 An industrial or warehouse rolling ladder also provides a safe position that can be used to document a vehicle from above, thereby recording a more informative photograph of the vehicle.

processed. Keeping a clean and organized facility is of paramount importance. No one wants to come to work in a trash-filled environment. Granted, processing vehicles is an extremely dirty job, but there are a few items that can make life a little easier and help control the mess around one's work area.

In order to keep the garage clean, it should go without saying that heavy-duty or thick rubber trashcans will be necessary. The trash receptacles need to be heavy-duty because they are going to be routinely filled with broken and sharp parts that have broken off vehicles and not just trash from the processing of vehicles. The trashcans should be on wheels since they will be moved around the garage routinely. Push brooms and dustpans are also necessary to sweep up the debris left behind by damaged vehicles. There is an unconventional device that is surprisingly helpful in cleaning up larger vehicle examination garages. The surprising device is an electric leaf blower. One does not need a gasoline-powered engine that will need routine care. An electric or battery-powered leaf blower is all that is needed, besides an extension cord to run the electric type. The leaf blower is used to blow all the accumulated dust, fingerprint powder, cobwebs, and anything else that builds up on surfaces and in the facility's hidden corners. The leaf blower should only be used when all the vehicle bays are empty. Also be sure to cover up or secure any loose items and papers because even basic leaf blowers can produce wind speeds over 100 miles per hour. Work from the back of the garage and blow everything out through the open garage doors and into the parking lot. On that note, the parking area around the facility should be routinely swept for screws and other sharp objects. Evidence technicians are naturally going to drive or park their personal vehicles near the vehicle examination facility and nothing will ruin a person's day quicker than getting a flat tire upon arriving at work. There is no way to keep the vehicle examination bays perfectly clean, but a messy work environment can be a dangerous and unpleasant work environment.

The damaged vehicles that are brought into the facility are naturally going to drip a variety of fluids and lubricants onto the garage floor or the parking area. Those assigned to work in such a facility should request a product called "Oil Dry" or "Oil Absorbent" for the facility. Oil dry absorbs moisture, even thick liquids like engine oil. Oil dry is a granular substance that is similar in consistency of kitty litter. Oil dry can be purchased in containers as big as 55-gallon drums or smaller 40-pound bags for those working in smaller facilities. In a pinch, but not as effective, kitty litter can actually be used as a temporary oil dry substitute. However, actual oil dry is much more effective with the higher viscosity of engine oil over cat urine.

Evidence technicians will also need to find a way to stay clean themselves while working in the dirty conditions of a vehicle examination facility. A large steel sink or two will be utilized frequently by evidence processors and is a must for the facility. Regular soap is not always the best cleaning agent to remove engine grime and fingerprint powder from one's skin. A product like "Fast Orange™" is much more effective at removing grime from one's skin. Another hint about the facility's wash station is to have real cloth towels and washcloths available. Paper towels work but are not nearly as effective as fabric towels. In addition, the sheer number of paper towels that will be needed for the number of times evidence technicians will be washing their hands during the course of the day makes their use impractical.

Regarding facility cleanliness, another convenient item to have around the garage are "Clean Room Sticky Mats." Clean room sticky mats are doormats placed on the garage's floor and in front of the doorway leading to the facility's "clean room," office, or whatever space that is away from the dirty environment of the garage's processing bays. The mats will help remove oil, fingerprint powder, and other debris off the investigator's footwear as they move from the garage and into the clean area. Maybe not so critical for smaller facilities, but for larger and more active vehicle processing facilities, it would be preferable if the place had a shower stall for employees. Fingerprint powder, sweat, and everything else will not only cover a person's hands and shoes but also stick to their hair, face, and any other exposed surface. One may believe that a shower is an unnecessary luxury, but in busier facilities, investigators may put their hands on hundreds of criminal cases a year. A significant number of these cases are bound to make it to trial. Even though many cases will plea out, enough will go to trial that while an investigator is working on one vehicle, they can routinely be called to testify in court, and they will need to have a place to clean up for court. For those lucky enough to be designing their own facility, the building will naturally be plumbed for water for the sink and commode. Plumbing in a shower should not be too great an expense to add into the design plans.

Obviously, the facility is going to need computer and telephone wiring. The garage setting can be a noisy environment to say the least. Having audio speakers mounted in the processing bays, both inside and outside, will help project the audible ringer loudly throughout the facility and will help prevent missing any calls. Along with the computer and telephone wiring in the facility, a security camera system is highly recommended. Impound lots are frequently the target of thieves and these crimes are frequently not immediately discovered. Security cameras and lighting on the facility's grounds can help diminish the desire of would-be thieves.

Personal amenities are the final touches on a respectable vehicle examination facility and something that will keep evidence technicians content and happy with their work environment. Processing vehicles day after day may become tedious at times and is not as glamorous as working crime scenes in the field. However, it is equally important. Every single vehicle is a crime scene in its own right and must be processed by technicians dedicated to their craft. Processing vehicles should not be done out of some arbitrary obligation or some infrequent or random assignment. Processing vehicles for evidence requires its own specific skill set, and the best evidence technicians will be the ones who are permanently assigned to a vehicle examination building. Providing amenities to those working in the facility will help technicians want to be assigned to the fairly dirty and less glamorous job of processing vehicles. Having a happy and consistent set of investigators working in a vehicle examination facility will result in a better end product. Amenities might include things like a refrigerator, microwave, and a place to eat that is well separated from one's workspace. Many employees, across all sorts of professions, eat at their desks, but because of the nature of the job crime scene investigators do, having a small eating area can be a pleasant relief from the reminders of the morbid tasks often asked of investigators that naturally are going to be present at an investigator's desk.

Crime Scene Investigation Equipment and General Supplies

In addition to mechanic's tools, general crime scene investigation equipment is going to be needed to process vehicles involved in criminal activities. The variety of cases that will enter a vehicle examination facility is nearly limitless, especially over the long term. The vehicles processed in the controlled environment of an examination facility typically are involved in more serious crimes and will include everything from property crimes to person crimes. In addition, a single vehicle may involve multiple crimes, as they are frequently stolen to be used in other more serious offenses. As a result, investigators must have a full arsenal of criminal investigation tools. Anything that could be found at a crime scene can be found on or inside a motor vehicle, and investigators must be prepared for every type of criminal investigation. More specific information on equipment specific to different tasks of an evidence technician processing vehicles will be found throughout this book, but what follows here will be the general crime scene investigation equipment one should consider having available and in abundance at the vehicle examination facility. Investigators, especially experienced ones, will have accumulated their own collection of preferred equipment, but for new investigators, this information might be of some guidance.

Before specific processing and packaging equipment is discussed, there is one item every crime scene investigator must have and that is an ample supply of latex gloves. Gloves should be purchased by the case and not by the box. Not too long ago, gloves may not have been as much of a necessity as it is nowadays with the ability of crime laboratories to find the most minute traces of DNA on items of evidence. Although gloves do not necessarily stop the transfer of DNA between the investigator and the evidence, with constant vigilance and the frequent changing of the gloves, then the possibility of contaminating evidence is minimalized. Gloves come in a variety of sizes from extra-small to extra-large, and an adequate supply of each size should be kept in stock. Of course, the glove sizes used by personnel permanently assigned to a vehicle examination facility should be maintained in greater quantity. However, all sizes should be stocked so that case detectives or other visitors to the facility can have gloves as well.

Fingerprinting Supplies

The one certainty about working in a vehicle examination facility is that the number one processing request will be the examination of a vehicle for latent fingerprints. As a result, the processing facility must have ample supplies of basic fingerprint supplies, including but not limited to the following:

- Basic black fingerprint powder
  - Standard black powders
  - Magnetic powders
- Rolls of fingerprint lifting tape or hinge lifters
  - Frosted and clear tape
  - Different widths: 4", 2", and 1" rolls
- Latent fingerprint backing cards
  - Glossy or plain backings
  - Different sizes: 3×5, 4×6, 5×7, or 8×10 (inches)
- Assortment of fingerprint brushes
  - Fiberglass brushes
  - Feather brushes
  - Assorted hairbrushes

There are numerous other fingerprint supplies that could be added to this list, but these are the very basic necessities to get one started. Please refer to Chapter 8 for a more comprehensive list of fingerprinting supplies and descriptions explaining the differences in the choices available in fingerprint processing supplies.

Photography Equipment

Every vehicle that enters the vehicle examination facility must be thoroughly photographed. Even if the vehicle was simply brought in for “safe keeping” and no processing was requested. It is always a good idea to photograph the exterior of the car at the very least, for no other reason than to protect evidence processors from false accusations about damage caused to the vehicle while in the custody of a law enforcement agency. Therefore, all facilities will need photographic equipment. Please refer to Chapter 5 for a full list of necessary photographic equipment, but a basic photographic supply list should include the following items:

- Single lens reflex (SLR) camera
- Memory cards (storage media)
- Electronic flash and flash-synchronization cord

- LED light stands
- Other quality ambient light sources
- Tripod and photographic copy stand

SLR cameras are recommended over point and shoot style of cameras, because they are much more flexible and capable of photographing the variety of challenges that face investigators, such as photographing laser trajectories or luminol reactions. Point and shoot cameras lack the flexibility offered by having an off-the-camera electronic flash. The built-in flashes on point and shoot cameras typically go straight out and straight back, which lacks the ability to angle the travel of light toward a subject. This can cause underexposures and bad reflections. Consequently, an off-the-camera flash unit and a flash-synchronization cable are recommended to eliminate those photographic errors. Investigators might also find that LED light stands are useful. Light stands or LED light strips can be easily purchased and used as a constant-ambient light source and they help the investigator eliminate harsh reflections, shadows, and exposure problems (Figure 2.11).

Tripods are a highly recommended piece of equipment that every facility should be equipped with. Photographs involving luminol or lasers often require longer, timed exposures. A photographer cannot hold the camera in their hands while recording those types of images. The tripod should be of sturdy or heavy construction so that it cannot be knocked over easily. Photographers will also benefit if they have a copy stand available to

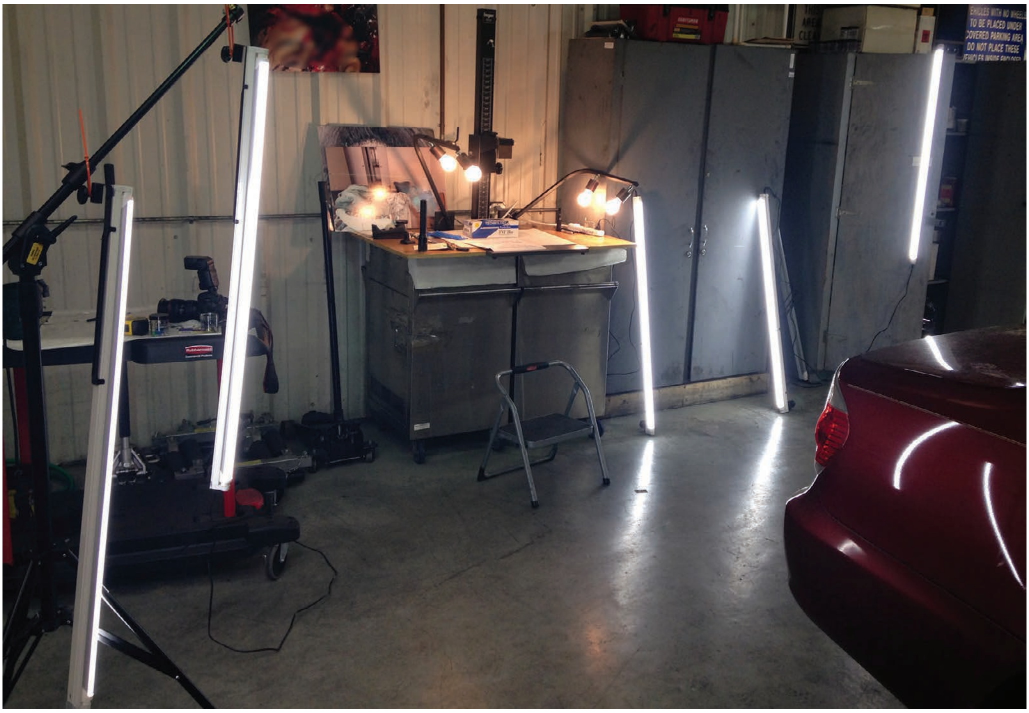

Figure 2.11 LED light strips are beneficial to photographers because they help cast an even and natural-appearing light across the entire subject and they help remove problems such as harsh reflections and dark shadows.

them. Copy stands are useful when documenting the smaller pieces of evidence recovered from inside of a vehicle. Tripods can be used as a copy stand in a pinch, but are more cumbersome to work with. A quality copy stand is more efficient for the photographer.

Documentation Equipment

In addition to the photographic documentation of vehicles, one will need an assortment of evidence markers, measuring devices, and assorted documents or forms to properly record all the vital information found in and on a vehicle. Keeping a quality record of everything done to the vehicle and recovered from the vehicle as evidence is vital to a successful criminal investigation. Consistency and continuity are a large part of the proper documentation of a vehicle. It is important for evidence technicians to keep a consistent numbering or lettering theme throughout a vehicle's documentation. Whatever one's preferred method of labeling or identifying evidence is, they will need an assortment of evidence markers, labels, and/or stickers to identify objects and evidence in the crime scene photographs. Because of the tight confines of a vehicle, standard 2" and 4" evidence tent markers are not as useful as they are on a typical crime scene. Evidence markers used in vehicle examinations should be smaller so that they can fit into the compact spaces found inside a vehicle, like underneath a car seat or inside a glove box (Figure 2.12).

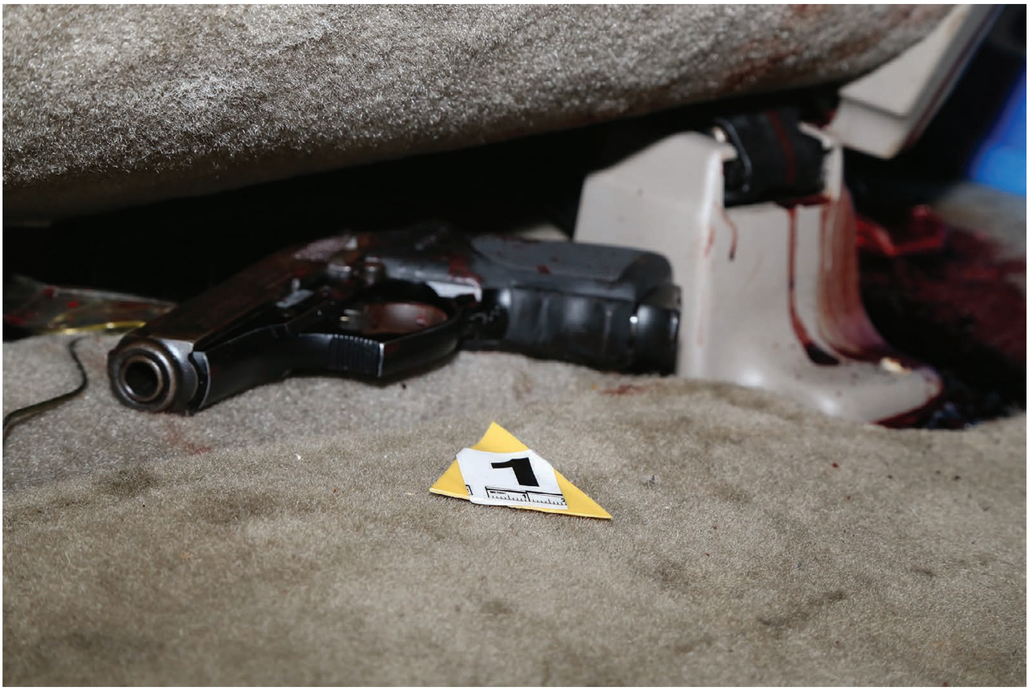

Figure 2.12 Evidence markers used for vehicle examinations are typically smaller than those used at other types of crime scenes. The smaller markers fit better in the smaller confines of a motor vehicle.

There is a constant need to measure evidence, notate the location of evidence, and record the overall condition of the vehicle itself. As a result, there is a variety of measuring devices that will be beneficial toward the processing of vehicles. The primary measuring device used by investigators is the steel tape measure. A steel tape measure is a necessity and can be used to measure everything from the overall dimensions of a vehicle to the placement of evidence inside a vehicle (Figure 2.13). A steel tape measure can measure the vertical heights of evidence that may be found on a vehicle, but if an investigator is working alone, then it may be difficult to photograph such information because a steel tape measure cannot stand up on its own. However, yardsticks can be taped or stuck with putty to the side of the vehicle for recording an informative photograph [Figure 2.14(a) and (b)]. Yardsticks can be purchased at any home improvement or hardware store, but forensic supply companies do sell yardsticks, sometimes referred to as “Spatter Sticks” because of their original use in documenting bloodstained crime scenes. Spatter sticks have large prominent inch marks printed on them and are more easily photographed.

Another type of ruler or scale that is a crime scene investigator’s necessity is the photographic scale. Photographic scales are discussed more thoroughly in Chapter 5, but for now, the basic scale possessed by an investigator is typically the American Board of Forensic Odontology (ABFO) #2 scale (Figure 2.15). The rigid plastic photographic scales are excellent choices in most situations, but there will be times that a piece of evidence is found on a curved portion of a vehicle and a rigid scale just will not work as well as “scale tape.” Scale tape is an adhesive-backed ruler that is disposable. The tape can be applied smoothly over a curved surface and results in better, more accurate photographs (Figure 2.16).

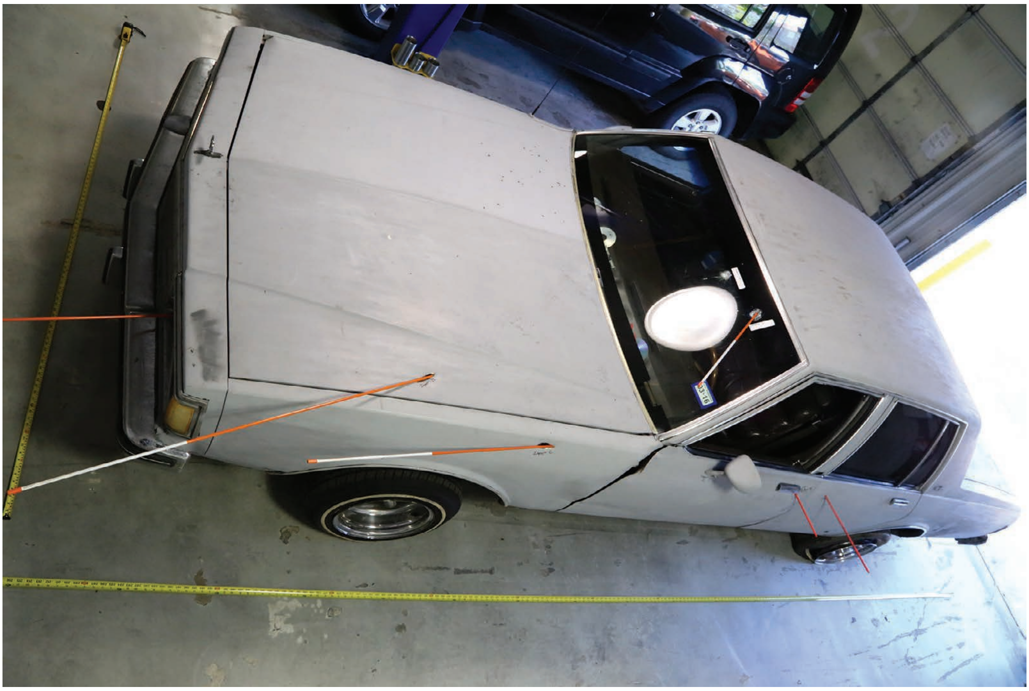

Figure 2.13 A steel tape measure can be used to measure the overall dimensions of a vehicle. In this photograph, the evidence technician placed the steel tape measure along the side of the car in order to record the baseline measurements for the bullet strikes found on the car.

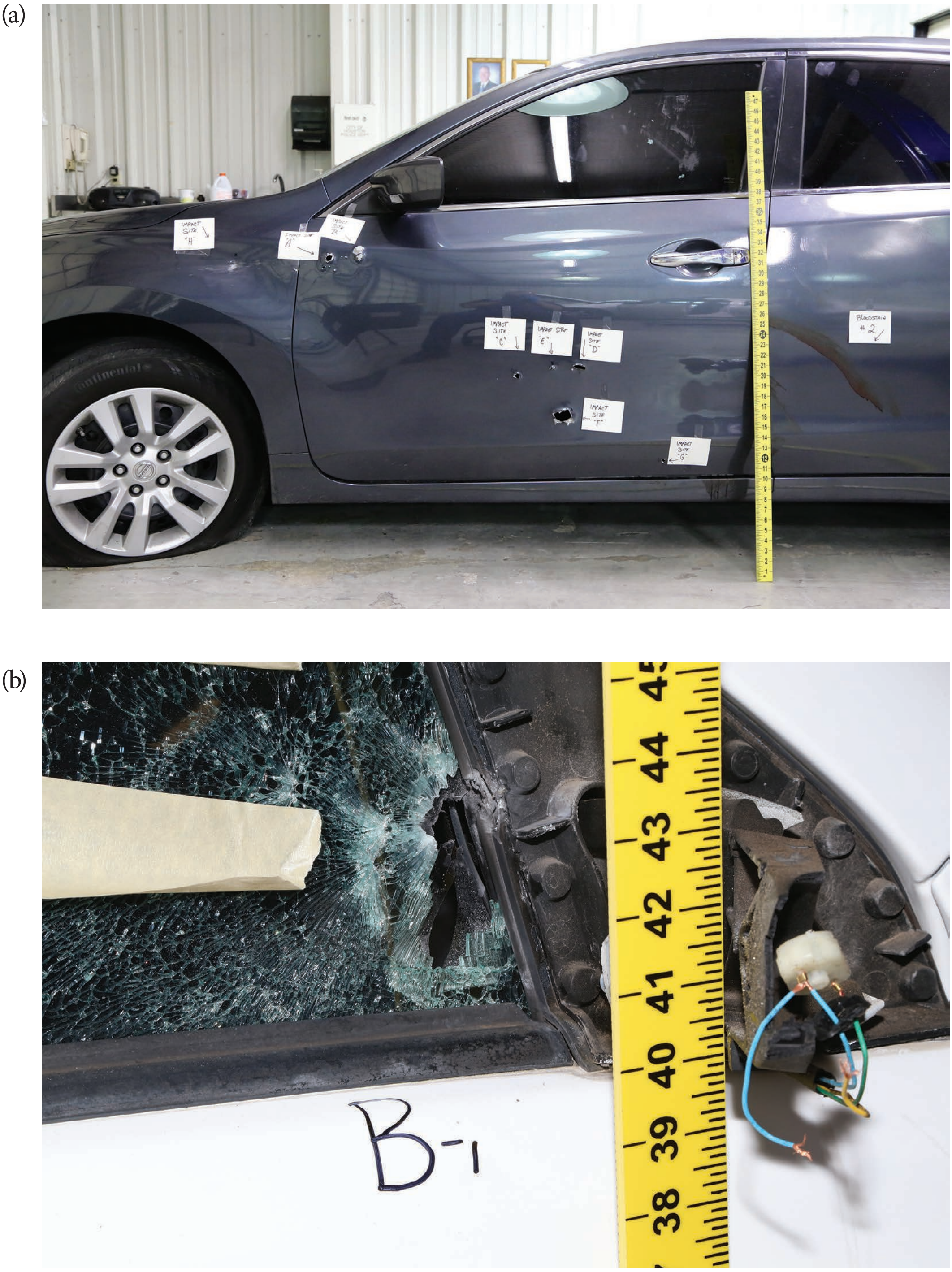
(a)
IMPACT SITE "H"
IMPACT SITE "C"
IMPACT SITE "E"
IMPACT SITE "D"
IMPACT SITE "F"
IMPACT SITE "G"
BLOODSTAIN #2
(b)
B-1

Figure 2.14 A yardstick or carpenter's ruler can be used to document the vertical height of a bullet hole or a particular bloodstain and is more easily photographed by an investigator working alone. Photographs should be taken from (a) an overall perspective as well as (b) a close-up perspective.

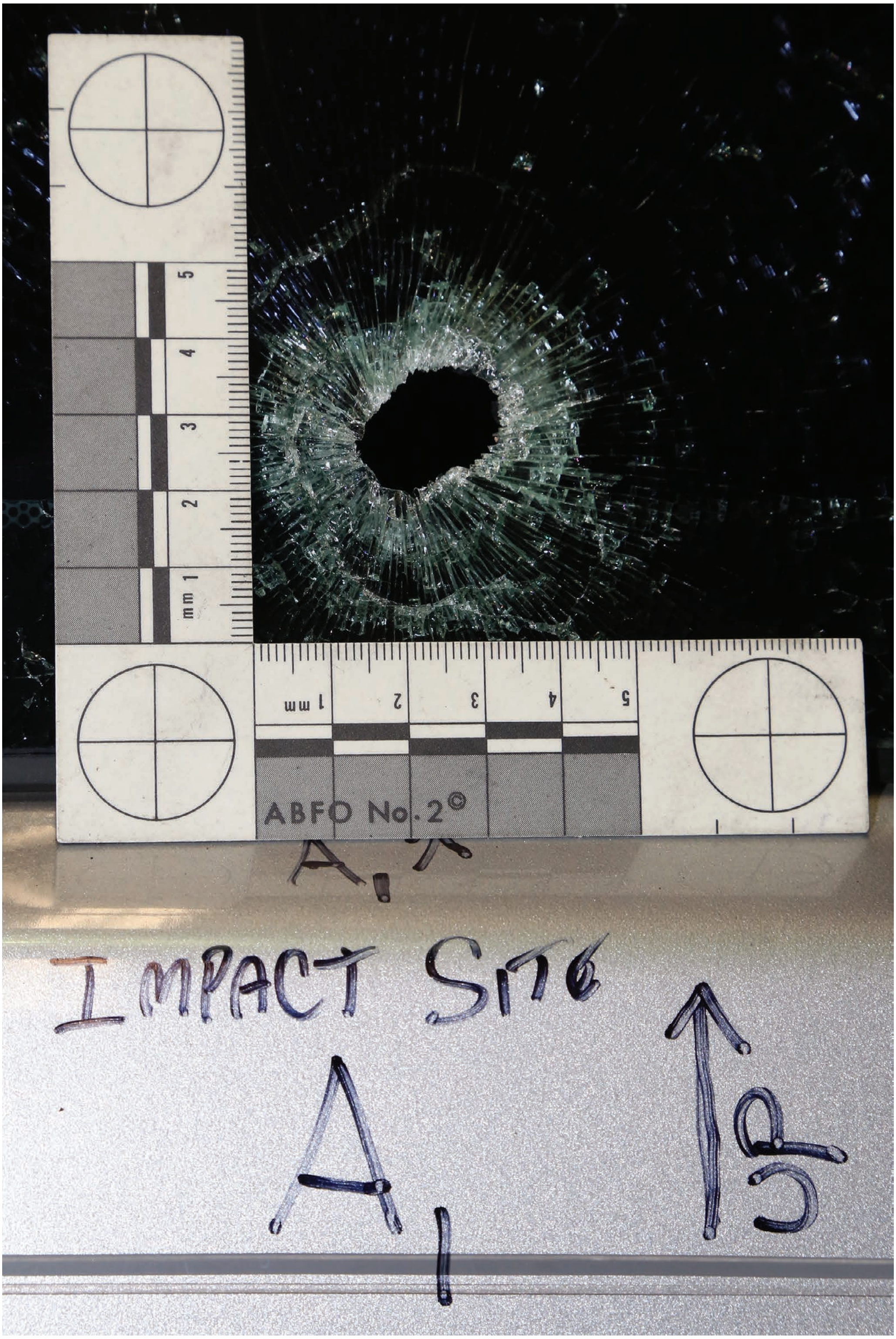
ABFO No. 2©
mm 1
2
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Figure 2.15 The ABFO #2 scale is a standard tool used by forensic photographers to document the relative size of evidence, such as the bullet strike pictured here.

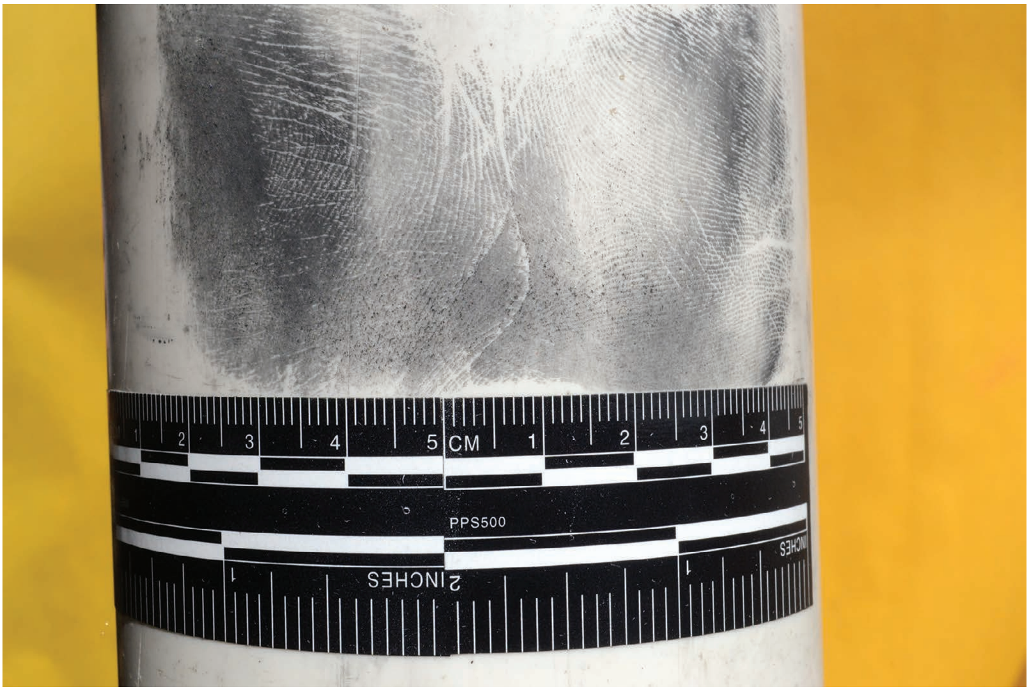


Figure 2.16 "Scale tape" is a better choice of scales when photographing curved or angled surfaces. Scale tape can adhere to undulating surfaces better than rigid, plastic photographic scales. Photographers should remember to use smaller apertures when photographing curved or angled surfaces to record deeper depth of field images.

When processing motor vehicles that have been damaged due to gunfire, evidence processors need a special type of measuring device: an angle finder. Angle finders come in digital and analog forms. Both forms work equally well, but the analog angle finders do not require a battery and are lighter weight. The lighter weight makes them easier to use when balancing them on a trajectory rod to find the angle at which the fired projectile penetrated the vehicle (Figure 2.17). Most analog angle finders have the added advantage of having a "V" groove along the base. This "V" groove allows the angle finder to balance easier on top of the trajectory rods. When measuring the impact angles of bullet strikes, they need to be clearly marked and identified. It is difficult to place tent markers on the side of a car. Therefore, using stickered numbers and letters is recommended.

Keeping a large supply of the various forms and papers necessary to keep everything running smoothly in a vehicle examination facility is vitally important. Even if an agency has computerized many of their evidence submission and similar forms, there are still a host of other forms that still need to be on paper and will be discussed throughout this book. For example, consent forms for vehicles and DNA samples will be a constant need. While processing vehicles, investigators will always use plain white paper, but sometimes having preprinted line drawings for different types of vehicles will make note recording a little bit easier. Some agencies may also have case packets that are required for each vehicle processed. Any or all of these forms that are completed during the processing of a vehicle need to be kept in ample supply. As mentioned earlier, evidence submission forms need to be well stocked, unless the investigator's agency has computer-generated submission

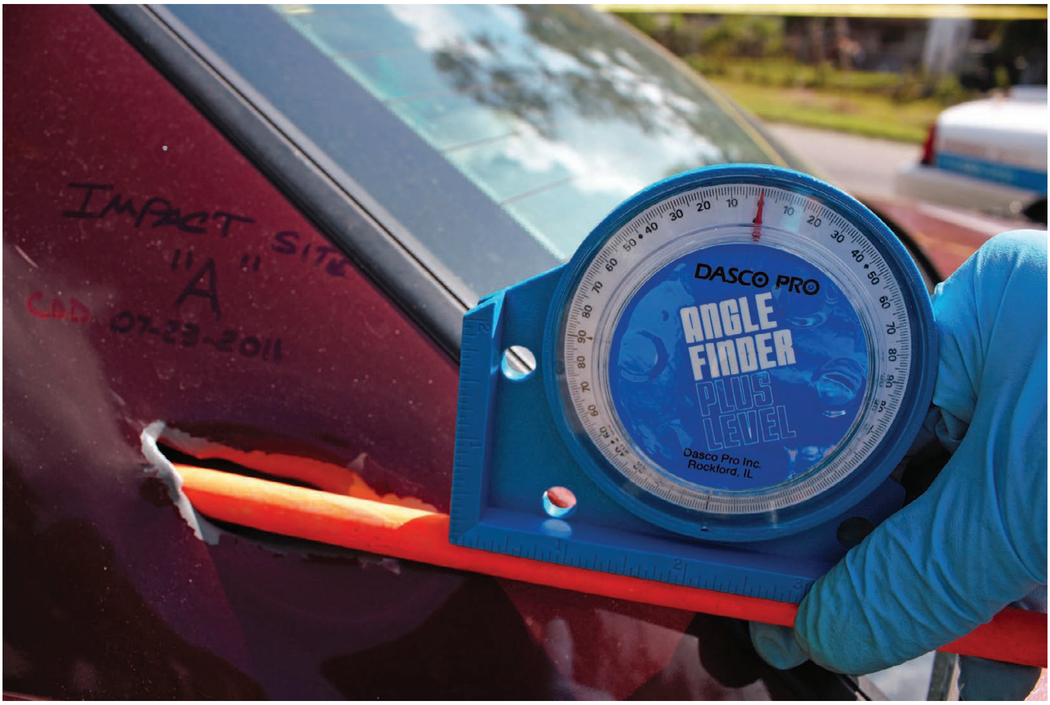


Figure 2.17 Angle finders are valuable tools in the documentation of vehicles that have been struck by gunfire and are used to determine a fired projectile's angle of impact.

forms. Each agency will have their own particular way of documenting a vehicle's processing, with their own unique documentation forms, everything from the vehicle submission to the vehicle release forms. Whatever the case may be, investigators should set time out at the start of their workweek to ensure that they have enough forms and papers to complete the week with plenty of spares.

Many of the more serious offenses investigated by crime scene investigators and for vehicles brought to any processing facility are likely to involve bloodshed. The documentation and collection of those bloodstains are important to understand what happened during the crime and help identify the individuals involved. The collection process of blood and DNA is detailed in Chapter 7. The tools necessary to more efficiently collect DNA and blood evidence include sterile swabs, distilled water, and an assortment of packaging materials (Figure 2.18). Specifically, some laboratories prefer their swabs be packaged in "swab boxes." Investigators may find that an atomizer or mist sprayer is a valuable tool for moistening swabs. Atomizers avoid the potential of cross-contamination and oversaturating the swabs with distilled water.

The documentation of bloodstains is detailed in Chapter 10. Measuring bloodstains is an everlasting chore of the bloodstain pattern analysts. Measuring devices such as steel tape measures, yardsticks, and/or spatter sticks were mentioned previously. These measuring devices are excellent for measuring the overall bloodstain patterns present, but crime scene investigators will also need to measure individual stains. Individual bloodstains, especially very small bloodstains, require finer measuring devices, such as

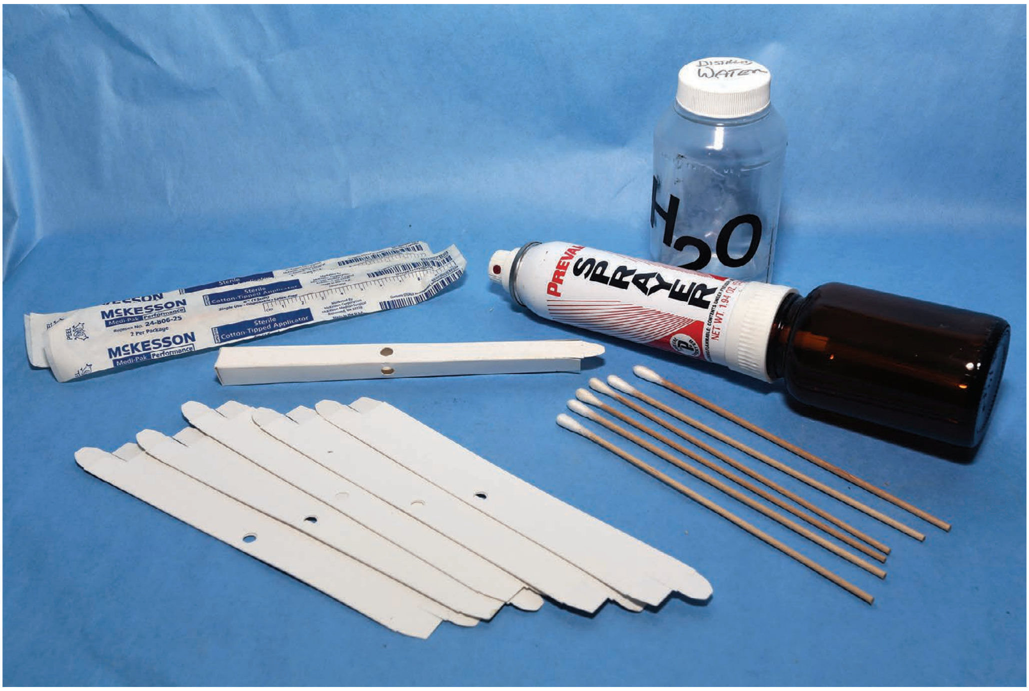
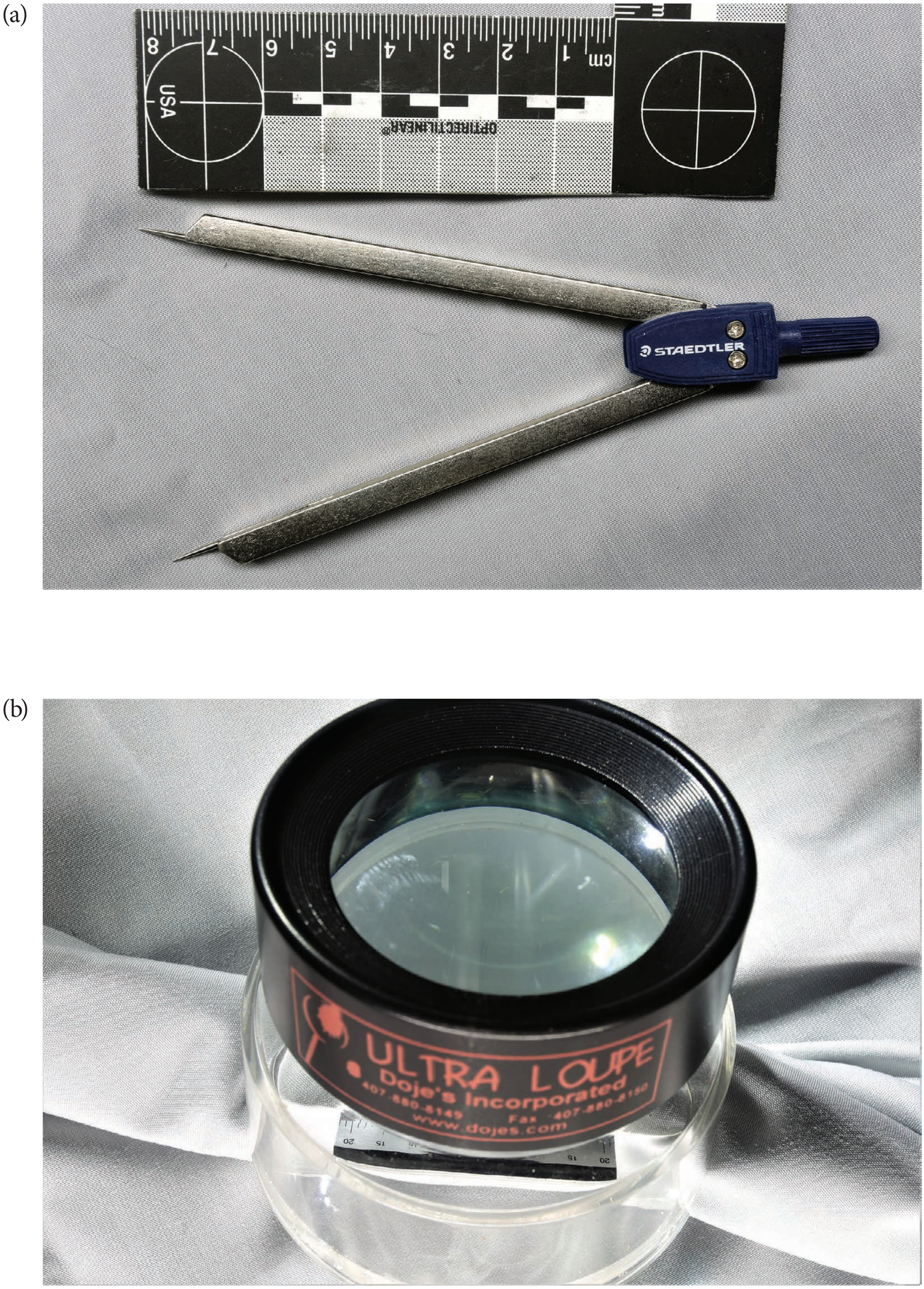


Figure 2.18 Collecting DNA swabbing samples is a very common task of vehicle examiners. The common tools include sterile cotton-tipped swabs, distilled water, and an atomizer for applying the distilled water onto the swabs. Swab boxes are not absolutely required for packaging but are preferred by many laboratories.

millimeter rulers, magnification loupes with built-in micro-rulers, and drafting compasses (Figure 2.19). Standard millimeter rulers and drafting compasses are good for measuring larger stains, but the stains created by high-energy events require a magnification loop that has a small scale built into it. The scale is typically broken down into two-tenths of a single millimeter. The extremely small measurement increments are needed for bloodstains created by gunfire.

Chemical enhancements are also commonly utilized by examiners. Presumptive tests for blood, such as Phenolphthalein, are frequently used by investigators to ascertain if a stain is blood or not. Chemiluminescent chemicals, such as luminol and Bluestar®, are used to help locate sources of hidden or cleaned-up blood. Other chemicals are used to enhance the presence of bloodstains. Chemicals such as Leuco Crystal Violet (LCV) and Amido Black are applied to enhance the presence of bloodstains and help identify bloodstain patterns and impressions. There is one last chemical that is beneficial to have around when dealing with human blood and that is hydrogen peroxide. Hydrogen peroxide is not used specifically for the processing of vehicles, but for the cleaning up of clothing and equipment afterward. Hydrogen peroxide breaks up bloodstains and helps dissolve them for easy cleanup.

Frequently accompanying bloodstained vehicles are vehicles that have been damaged by gunfire. These vehicles take a lot of time to document and process. The documentation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www.dojes.com
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Figure 2.19 Bloodstain patterns are typically measured in millimeters and fractions of millimeters. Investigators will need to measure individual bloodstains and that is done with (a) millimeter scales and drafting compasses and (b) magnifying loupes with built-in micro-rulers.

of gunfire-damaged vehicles includes measuring the angles of impact and the flight paths or trajectories of fired bullets through a vehicle. To assist in that endeavor, investigators use a variety of tools including the following:

- Trajectory rods
- Angle finders
- Trajectory or forensic protractors
- Colored string, stringing kits, and/or trajectory lasers

Tracking trajectories is another common task of evidence technicians, and these items help them follow the paths of bullets through a motor vehicle. One can find all of these items packaged together in shooting reconstruction kits that are offered for sale by a number of crime scene supply companies (Figure 2.20). The kits are well organized and come in easy-to-carry boxes or backpacks. The trajectory rods in these kits are generally made of metal. Alternatives to the metal trajectory rods can be found at home improvement stores and are the 4-foot-long fiberglass driveway or pavement markers. The fiberglass rods flex a little better than the metal rods and can accommodate a bullet's flight path that might bend or deflect as it travels through thick-padded seating. Trajectory rods can also be made of wood. Dowel rods can be found at the same home improvement store and because the dowel rods come in different diameters, they can accommodate different size bullet holes found on vehicles.

In addition to the angle finders described earlier, forensic protractors are also used to measure angles of impact. Forensic protractors are heavy plastic protractors, but the important aspect of them is that they have a "zero edge." Common protractors used in classrooms do not have a zero edge and cannot be used effectively to measure angles of impact on a vehicle or at a crime scene. The zero-edge protractor has its bottom edge leveled at zero degrees (Figure 2.21). Protractors used in schools typically have a space

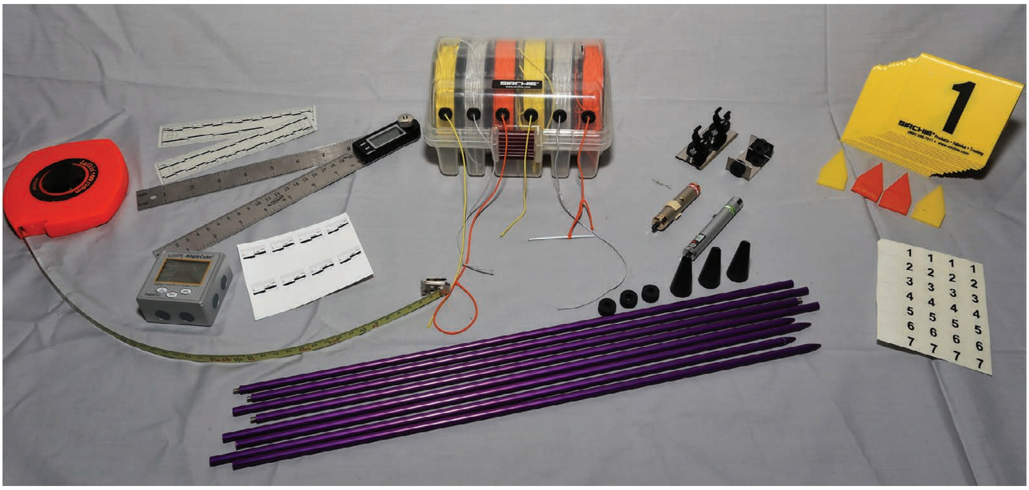

Figure 2.20 Shooting reconstruction kits that are sold by crime scene supply companies provide all the tools necessary to document the scene of a shooting or a vehicle that was damaged in a shooting. These kits include a variety of trajectory rods, lasers, and measuring devices.

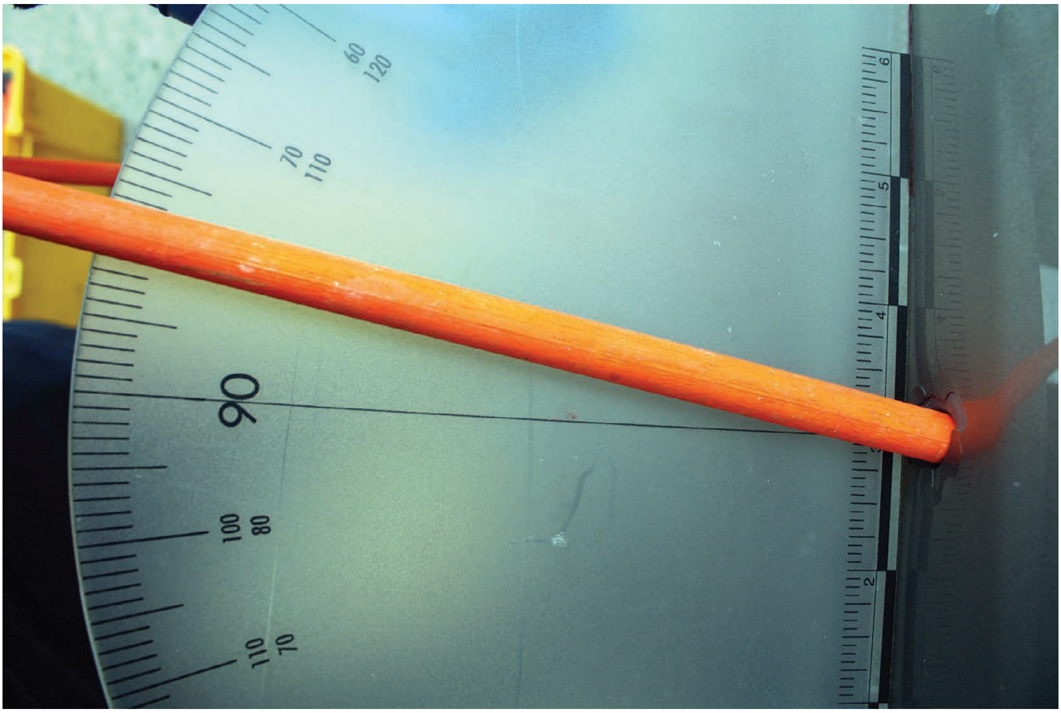

Figure 2.21 Forensic protractors have a "zero-edge" which gives an accurate angle determination in measuring impacts sites on a vehicle. A "zero edge" ensures that the angle of impact is determined from the point of impact and not from some point out and away from the impact site. Even a few millimeters of difference in space can cause a significant error in impact angle calculations.

between the base and the degree-increment markings. Colored strings and trajectory rods are used to show the flight paths of fired bullets and are often used along with the forensic protractors for measuring impact angles.

Packaging Supplies

Another staple of evidence processing is packaging all of the recovered evidence in a way that the laboratories will receive it in the most pristine condition as possible. Evidence packaging is discussed in greater detail in Chapter 3 and reinforced in other chapters. However, for now, a list of packaging materials might include the following:

- Plastic packaging
  - Different size plastic envelopes: 2×2, 5×7, 9×12, and 13×18 (inches)
  - Plastic tube sleeves or wrap (for elongated items, like rifles and baseball bats)
  - Plastic knife and needle tubes
- Paper packaging
  - Cardboard boxes of all sizes
    - Specialty boxes—DNA swab boxes
    - Specialty boxes—gun boxes

  - Paper bags of all sizes
  - Paper envelopes
  - Glassine envelopes
- Butcher paper
- Packing tape
- Clear cellophane tape (narrower than packing tape)
- Evidence or tamper-resistant tape
- Scissors and knives
- Sharpie or other permanent markers

This is not a full or comprehensive list of packaging supplies, but it is enough to package pretty much anything recovered from a vehicle. Different laboratories and agencies might have specific packaging requirements, and if they do, investigators just need to keep an ample supply of those packaging supplies. When possible, it is recommended that storage of these supplies should be away from the powder processing areas or examination bays inside the facility. It is also best to keep all supplies stored in plastic bins in order to keep them clean from floating fingerprint powder. Items like rolls of fingerprint tape and swab boxes can go into shoebox-size containers, while the assorted bags and boxes can go into larger size plastic storage bins.

Conclusion

Providing quality processing of vehicles is not an inexpensive proposition. It requires a full complement of crime scene and forensic tools and equipment. Budgets for crime scene units and vehicle examination facilities are typically limited and investigators must let the powers that be know what is high on their priority lists. The basics, like fingerprinting and packaging supplies, should always be included in a yearly budget, but when there are discretionary funds, investigators can start choosing one or two items that they believe will make the processing of vehicles more efficient and offer better end results. Building up a good variety of mechanics tools and forensic equipment over time will help establish an efficient and quality vehicle examination facility. In the end, having a well-supplied examination facility will help evidence technicians work smarter, not harder.

Additional Readings

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Review Questions: Vehicle Examination Facility and Processing Equipment

1. What is a major advantage of processing a car in a vehicle examination building versus completing the processing in the field?
   a. Light
   b. Time
   c. Space
   d. Distance
2. Why should a vehicle examination facility have an outdoor processing area as well as an indoor processing garage bay?
   a. Fresh airflow in outside processing bays is better for fingerprint processing
   b. Outdoor processing bays are better for photography
   c. Processing putrid-smelling vehicles is best done outdoors
   d. All of the above
3. What can cause damage to air conditioners and heaters inside of a vehicle examination building?
   a. Fingerprint powder can clog the air intake filters
   b. Car fumes can combust inside the air units
   c. Units must run extra-long to control the temperature
   d. Units are unable to control the temperature of facilities with large uninsulated garage doors
4. What is a major benefit of using LED lamps for processing bay lighting?
   a. LED lamps are less expensive than other lighting systems
   b. LED lamps add heat to colder environments
   c. LED lamps are brighter than other lighting systems
   d. LED lamps are color balanced for a true white color
5. Which type of lighting is helpful in the search for semen?
   a. Incandescent lighting
   b. Ultraviolet lighting
   c. Infrared lighting
   d. LED lighting
6. What is important to remember when raising a vehicle on a “car-lift?”
   a. Ensure the vehicle is properly balanced on the lift pads
   b. Ensure the vehicle is in “Park” prior to lifting
   c. Ensure the lift’s safety pin is engaged
   d. Ensure the safety harness has been attached to the vehicle
7. How might an investigator move a vehicle with flat tires?
   a. Forklift
   b. Wheel dollies
   c. Fill the tires with air
   d. All of the above
8. Which shop tool would be helpful in removing a stubborn lug nut from a car’s wheel?
   a. Crescent wrench
   b. Impact wrench
   c. Box-end wrench
   d. Channel-lock pliers

9. When trying to unlock a vehicle without a key, what is used in the "Break-In Kit" to separate the door from the door's frame?
   a. Prybar
   b. Large screwdriver
   c. Air bladder
   d. Small pneumatic jack
10. What can be placed over workstations to help keep the area clean while processing evidence?
    a. Butcher paper
    b. Unused newspapers
    c. Clean towels
    d. Plastic trash bags
11. What unconventional items can be used to clean fingerprint powder, dust, and small debris out of the garage bays?
    a. Industrial fans
    b. Magnetic sweeper
    c. Vacuum robot
    d. Leaf blower
12. What is the best product to clean up engine oil spilled on the garage floor?
    a. Absorbent paper towels
    b. Shop rags
    c. Oil-dry
    d. Kitty litter
13. Which product is best to remove stubborn fingerprint powder, oil, etc. from an investigator's hands?
    a. Liquid soap
    b. Fast Orange cleaner
    c. Isopropyl alcohol
    d. 409® cleaner
14. What type of camera was recommended for the photographic documentation of motor vehicles?
    a. Point and shoot cameras
    b. Single lens reflex cameras
    c. Medium format cameras
    d. Film cameras
15. What is the primary measuring tool of crime scene investigators, especially those working on motor vehicles?
    a. Steel tape measures
    b. Metal yardsticks
    c. Laser measuring devices
    d. Scale tape
16. Which measuring device is a staple of scale photography?
    a. Steel tape measures
    b. Scale tape
    c. ABFO #2
    d. Spatter sticks

17. What is an advantage SLR cameras have over “Point and Shoot” cameras?
    a. SLR cameras have greater flexibility, especially regarding the flash capabilities
    b. SLR cameras have greater depths of field
    c. SLR cameras have additional “Stops of Light”
    d. SLR cameras do not suffer from the “Inverse Square Law”
18. What can be used to help clean blood off of equipment or out of clothing?
    a. Luminol
    b. Leuco Crystal Violet
    c. Hydrogen peroxide
    d. Amido Black
19. Regarding vehicle lifts, which of the following statements is most true?
    a. Only certified users should operate the lift
    b. Lifts should not be used to raise pick-up trucks
    c. Lifts should be inspected periodically
    d. Never stand underneath a vehicle raised on a lift
20. It is safe to work underneath a car lifted solely by a hydraulic jack.
    a. True
    b. False

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General Guidelines and Strategies for Processing Vehicles

3

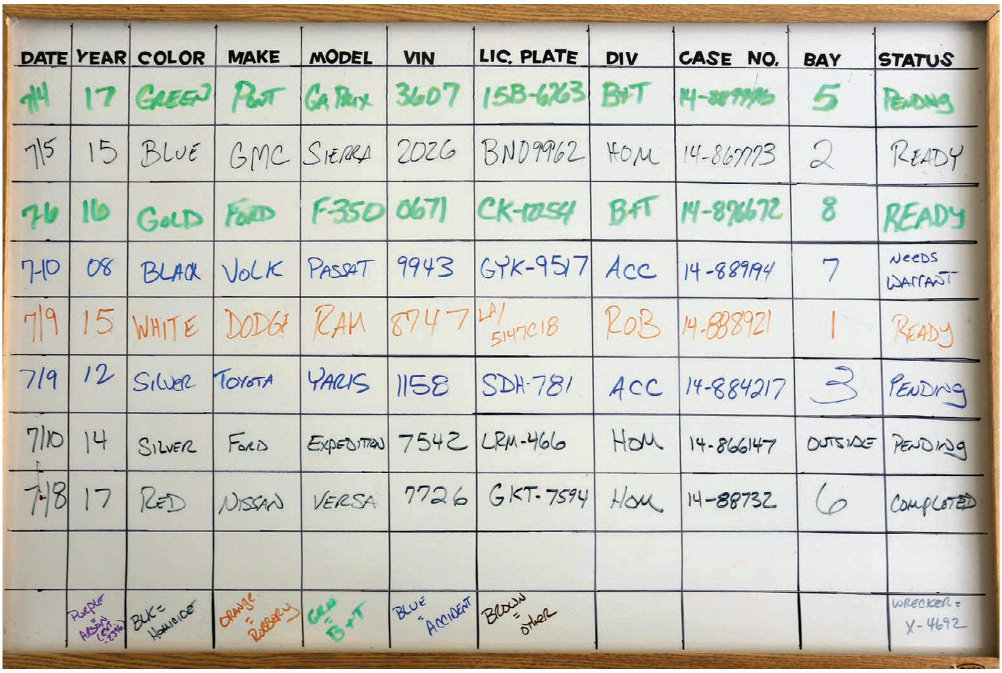
Creating an environment that is well organized and allows for the efficient processing of vehicles is critical to the overall operation and maintenance of a professional facility. A well-organized facility will ensure that every vehicle that enters an examination facility must be accounted for and tracked from the time of its arrival to the time of its release. This is mandatory in order to maintain the chain of custody. Failure to maintain chain of custody may result in recovered evidence being inadmissible in court. This tragic error would effectively eliminate any value a vehicle processing facility might hold. Organizing one's operation will also help those working in vehicle examination facilities because they are going to field a seemingly endless stream of phone calls and e-mails from investigators with information regarding their case vehicles and those wanting to know the status of their vehicles. In addition, phone calls will be coming in from victims and complainants wanting to know when they can pick up their vehicles. An important part of the facility's organization and maintaining chain of custody is ensuring the legality of a vehicle's search, that is, keeping track of a vehicle's status regarding the need for a warrant or a consent to search. Clearly, a well-run facility requires quite a bit of paperwork and documentation.

For larger and busier vehicle examination facilities, it would be beneficial if the facility has a vehicle coordinator or facility manager of some type. This person's responsibility is not to process the vehicles but to coordinate the processing of all the vehicles. This individual's job is just as important and as time consuming as the evidence technicians. By having a facility coordinator, the evidence technicians can concentrate on their own responsibilities revolving around the examination of vehicles. The coordinator tracks all the vehicles in and out of the facility, manages all the communication with case investigators, and ensures that each vehicle has the necessary consent or search warrant. Busy vehicle examination facilities' phones will ring off the hook, everyone from investigators and vehicle owners checking on the progress of their vehicles to prosecutors needing a vehicle examiner to testify in court. Handling all the phone calls and e-mails is a time-consuming chore and can take away from an evidence technician's ability to focus on their duties as vehicle examiners. Continuously stopping one's examination and processing to answer a phone is not the most efficient way to run a busy facility. Therefore, supervisors of busy facilities should do their best to staff the facility with a coordinator or manager. Regarding staffing, having evidence processors that are dedicated to the processing of vehicles for the vast majority, if not all, of their duty hours is also highly recommended. Processing vehicles requires a learned set of skills that is only achieved through. Like any other skill set, the unique knowledge learned through experience is better grasped and utilized by those who deal with motor vehicles on a daily basis. In addition, when general crime scene investigators and evidence technicians who are sent randomly to process vehicles every so often is inefficient and the quality of work may suffer because of a lack of a vested interest. Working on vehicles may not be as exciting or celebrated as working crime scenes in the field, but it is equally as important. In the end,

DOI: 10.4324/9781003204336-3

a quality staffed facility of those interested and dedicated to the processing of vehicles is of immeasurable value to any law enforcement agency.

Different agencies will have a variety of ways to keeping track of the vehicles that come in and go out of their processing facilities. Some agencies may have their vehicles tracked on paper and some may have them tracked via a computer program or some combination of the two. Just as important as keeping a record of the vehicles is having quick access to the information. Computers have revolutionized the way police work is documented and recorded. However, navigating through sign-on screens and the software containing the needed information can be frustrating, especially when there is an impatient investigator or complainant on the telephone wanting information immediately. As a result, having something like a large dry-erase board in the facility's office that contains real-time information about the vehicles currently in the facility and the status of those vehicles is recommended. A dry-erase board that can be updated immediately with vehicles moving in and out of the facility will help the evidence technicians prioritize the vehicles needing processing, and when someone contacts the facility to check on a vehicle's status, they can be given a quick answer. A hard copy of all the vehicles processed can still be kept in paper or digital form, but having an easily viewed list of vehicles helps make the facility run more efficiently. Agencies that do not receive the volume of vehicle processing requests may not need such a vehicle tracking board. However, larger agencies that have vehicles moving in and out of their facility on a daily basis will benefit by having this dry-erase board recommendation (Figure 3.1).



DATE	YEAR	COLOR	MAKE	MODEL	VIN	LIC. PLATE	DIV	CASE NO.	BAY	STATUS
7/4	17	GREEN	PONT	GA PRIX	3607	15B-6263	B+T	14-889996	5	PENDING
7/5	15	BLUE	GMC	SIERRA	2026	BND9962	HOM	14-867773	2	READY
7-6	16	GOLD	FORD	F-350	0671	CK-1254	B+T	14-896672	8	READY
7-10	08	BLACK	VOLK	PASSAT	9943	GYK-9517	ACC	14-889194	7	NEEDS WARRANT
7/9	15	WHITE	DODGE	RAM	8747	LA/ 5147C18	ROB	14-888921	1	READY
7/9	12	SILVER	TOYOTA	YARIS	1158	SDH-781	ACC	14-884217	3	PENDING
7/10	14	SILVER	FORD	EXPEDITION	7542	LRM-466	HOM	14-866147	OUTSIDE	PENDING
7/18	17	RED	NISSAN	VERSA	7726	GKT-7594	HOM	14-88732	6	COMPLETED
	PURPLE = ARSON (EXT. 2396)	BLK = HOMICIDE	ORANGE = ROBBERY	GRN = B+T	BLUE = ACCIDENT	BROWN = OTHER				WRECKER = X-4692

Figure 3.1 Keeping an easily accessed record of the vehicles that are moving in and out of an examination facility helps maintain an organized and efficient work environment. Any busy examination facility would benefit from having a dry-erase board possessing the vehicle's information and status so that the information can be accessed quickly. The dry-erase board also allows for easy changes and updates to the information.

Whether a facility keeps their real-time information in paper form and/or a dry-erase board, the basic information should include the Vehicle Identification Number (VIN), basic case information, and the vehicle's status information, similar to the following table:

Date of Entry	**Year**	**Color**	**Make**	**Model**	**VIN (Last 4)**	**License Plate**	**Division**	**Case # and Name**	**Status**	**Bay #**

This table can be kept on paper or in some sort of spreadsheet computer program, but having it on a large dry-erase board is going to make it much easier to make the daily changes to the board and to have quick access to what is going on in the facility at any given time. Those processing vehicles can adjust this format to their particular needs, but the first column is generally considered the first priority and that is "first come, first served." Of course, that is not always the case, but knowing how long a vehicle has been sitting at the facility may help when it comes time to decide which vehicle gets processed before another. The next columns are simply to document the vehicle's information, which includes the year, make, model, color, license plate number, and last four digits of the VIN. Because it is not unlikely that similar cars will show up at a facility at one time, recording the last four digits of the VIN acts as a double check for the evidence technician. The next two columns are the case information and include the concerned division, case investigator's last name, and the case or incident number. Because homicide cases generally get a higher priority than burglary cases, the concerned division information is another important factor in determining priority in the order the vehicles are processed. Another recommendation is to color code the information on the dry-erase board. For example, all homicide vehicles will have all the information written in red, while other divisions are written in different colors. By color-coding the information on the board, it simply helps organize the information and provides an understanding of what is going on in the examination facility at any given time. The next to last column is the vehicle's status. The status box is important to know which vehicle is ready for processing, ready for release, etc. The different statuses might include the following:

- *Ready*—Vehicle is ready for processing.
- *Pending*—Vehicle is waiting for a warrant, consent, or contact from an investigator.
- *Release*—Processing of the vehicle is complete and the vehicle is ready for release.
- *Priority*—Vehicle is ready for processing, but is time sensitive due to an issued search warrant or high-profile investigation.

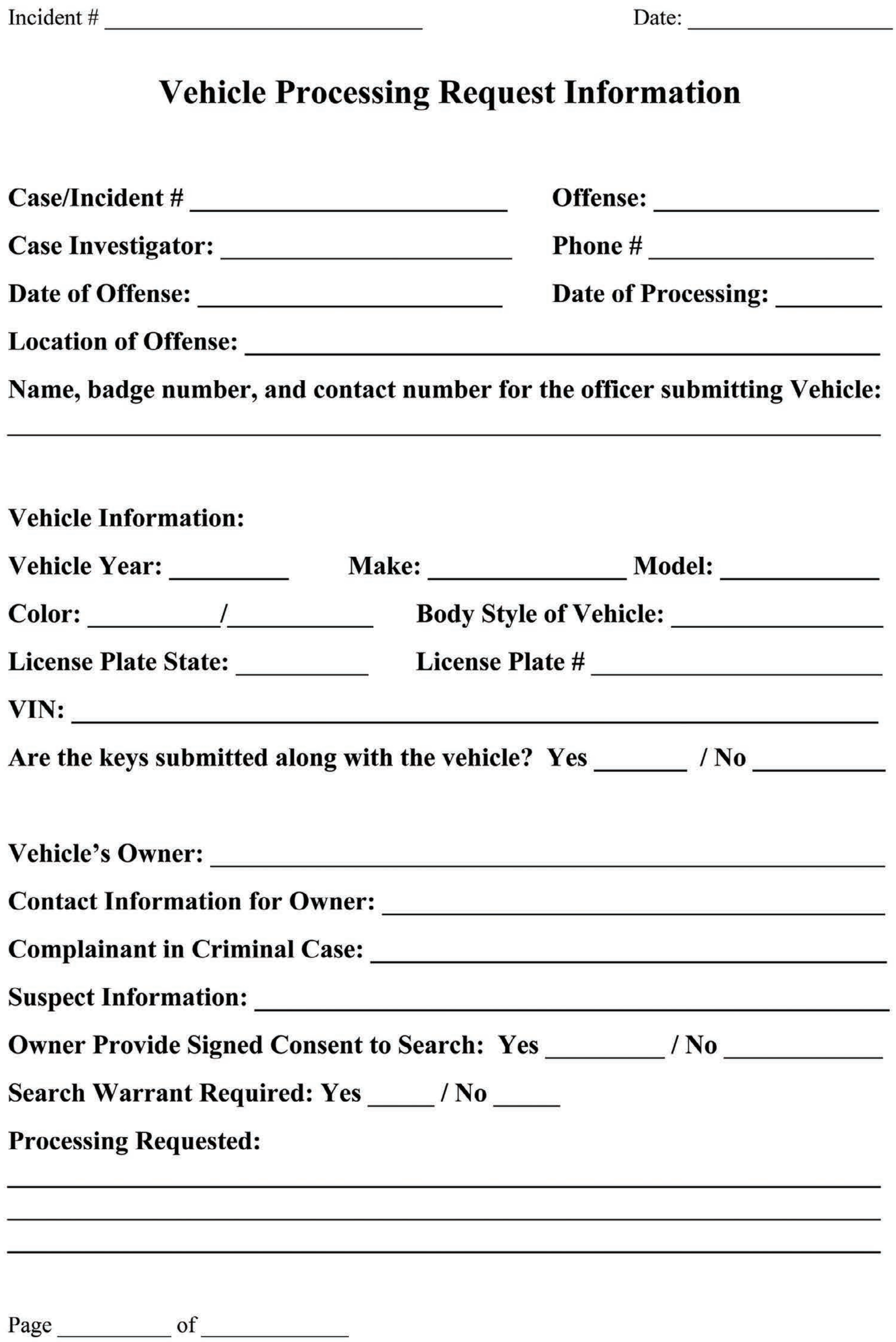
The final column on the board is where the vehicle is located: for the larger facilities, placing the examination bay number in the box or if it is located in the overflow parking lot, and if the vehicle is located in a police impound lot or some other off-site location, then that information would be quite helpful to the evidence technician assigned to process the vehicle.

Admitting Vehicles to the Examination Facility

Before a vehicle can be processed at an examination facility, it must be towed to the facility. Hopefully, one's agency already has protocols in place, which stipulate that police officers must escort any vehicle being towed from a crime scene to the place where the processing of vehicles is completed. This is a necessary protocol to maintain chain of custody for any potential evidence recovered from the vehicle. Because a vehicle may arrive at a facility 24 hours a day and 7 days a week, regardless of the agency's size, there are bound to be times when a vehicle is going to be "dropped off" (submitted into evidence) at an unattended facility. As such, there must be clear instructions and paperwork to clearly identify the steps to transfer the vehicle's custody to the facility and those working there. In addition to any vehicle submission forms that may be required, agencies will likely have a logbook of all officers and tow-truck drivers who enter the facility, regardless of the reason. The logbook should be stored in the area where the submission forms and instructional signage is positioned. Clear signage and examples of the necessary paperwork are going to be important so that police officers follow a clear set of instructions and/or protocols. One would think common sense and professionalism would ensure that every vehicle would enter the facility correctly, but that is not a real-world truth. Larger agencies might be fortunate to have 24-hour management over a facility, or at the very least, a supervisory review of vehicle submissions, but for those facilities that do not have such supervision, then they will need to provide clear guidance to those officers about to enter their examination facility. One must remember that a street officer may only submit a single vehicle into a processing facility once a year, and they cannot be expected to remember each and every task without some form of simple guidance.

The first item needed will be some type of submission form (Figure 3.2). Each agency will have their own submission forms for vehicles, but there are some important pieces of information that will be necessary to process the vehicle properly. Obviously, the vehicle information is important, but not every vehicle is going to be submitted in a condition where the identifying information is easily obtained. Therefore, the vehicle information can be filled out as complete as possible, but a couple of the items that are most important is the correct case or incident number and whoever requested the vehicle to be processed. The evidence technician, or if the forensic unit has a person that coordinates the facility, will need to know whom to contact (case investigator) in order to confirm exactly what needs to be done to the vehicle and ascertain whether the investigator has obtained a warrant or consent to legally enter the vehicle. One more important piece of information is whether or not the vehicle came with keys. It is always a good idea for those working at the examination facility to double-check all the information on any submission form because sloppy and/or inaccurate entries will be found from time to time.

For those agencies that do not have 24-hour staffing at their vehicle storage or processing facility, then leaving clear instructions is going to be necessary. It may be sad to have to give this warning, but any investigator who spends time working in a vehicle examination facility will see every possible level of incompetence and ignorance from those who do not frequent such a facility. One cannot necessarily blame the officer, because they may not have to submit a vehicle but once in a blue moon. The clear instructions and signage are necessary for those officers who are unfamiliar with vehicle submissions. In addition to any signage that helps give instructions as to what paperwork needs to be completed,



Incident # ______________________________ Date: ___________________

Vehicle Processing Request Information

Case/Incident # ______________________________ Offense: _____________________

Case Investigator: ____________________________ Phone # _____________________

Date of Offense: _____________________________ Date of Processing: ________

Location of Offense: ____

Name, badge number, and contact number for the officer submitting Vehicle:

____

Vehicle Information:

Vehicle Year: _________ Make: _______________ Model: ____________

Color: __________/___________ Body Style of Vehicle: ________________

License Plate State: __________ License Plate # ______________________

VIN: ____

Are the keys submitted along with the vehicle? Yes _______ / No __________

Vehicle's Owner: ____

Contact Information for Owner: ______________________________________

Complainant in Criminal Case: _______________________________________

Suspect Information: ____

Owner Provide Signed Consent to Search: Yes _________ / No ____________

Search Warrant Required: Yes _____ / No _____

Processing Requested:

____

____

____

Page __________ of _____________

Figure 3.2 Some type of vehicle submission form for the facility will be necessary to maintain chain of custody of the automobile, whether the examination facility's staff is present or not at the time of the vehicle's arrival. It is recommended that an example of the form is posted near the area where the forms are stored, with highlighted instructions for arriving law enforcement officers.

other instructions regarding facility safety might be worthwhile. For example, one may need signs indicating to turn vehicles off prior to placing them inside a facility. One might believe that would be common sense, but the excuse given as to why the vehicle was left running was that the officer did not want to contaminate the vehicle with their DNA by reaching inside the vehicle to turn it off. Sometimes a sacrifice in DNA collection must be made so that the vehicle and the building do not burn down. Regarding keys, a clear sign or pegboard should be present reminding officers to leave all vehicle keys with the vehicle. Not much is worse than arriving to work in the morning and calling up a nightshift officer that is sleeping and informing them that they must wake up and bring the set of vehicle keys back to the examination facility. Other signs might be necessary for the protection of the facility, such as not placing vehicles that have no wheels inside the garage. Vehicles without wheels, not just flat tires, but without wheels, generally take a little finessing with a forklift to raise the vehicle off the floor, which may gouge or otherwise damage the garage floor. If a vehicle without wheels needs to be left inside a facility, the vehicle should be placed on a set of wheel dollies. If there are gates or garage doors that must remain free from blockage, that too should be signaled with clear signage (Figure 3.3). Otherwise, vehicles are bound to be dropped by tow-truck drivers and block access to important parts of the facility. In the end, whatever an agency deems to be most important at their facility regarding the submission of vehicles into evidence, those tasks should be clearly and boldly posted for all to see.

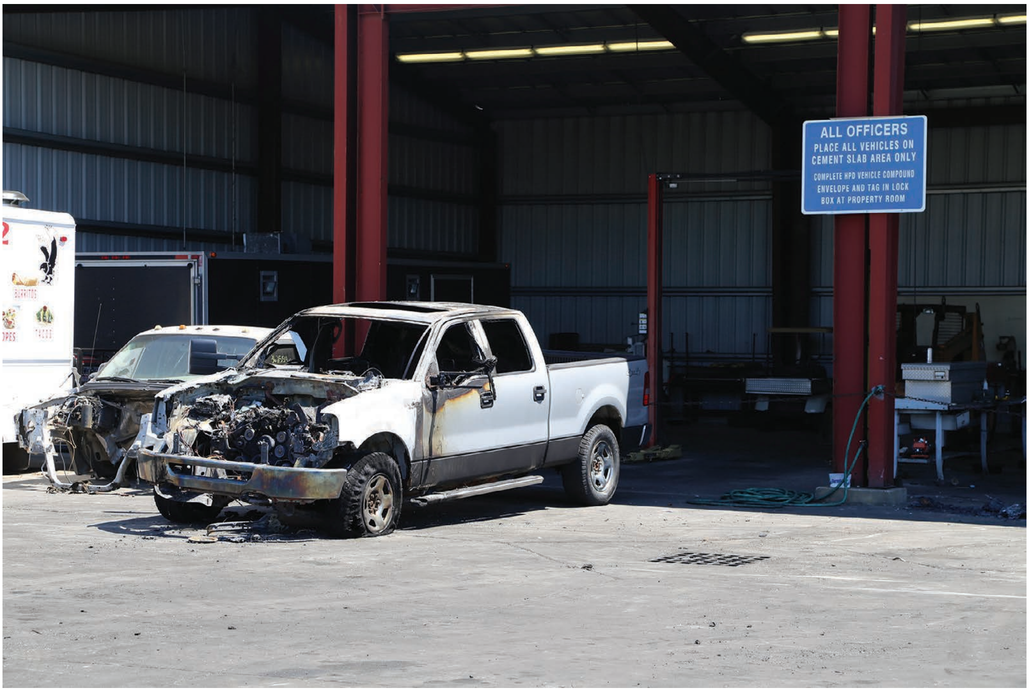
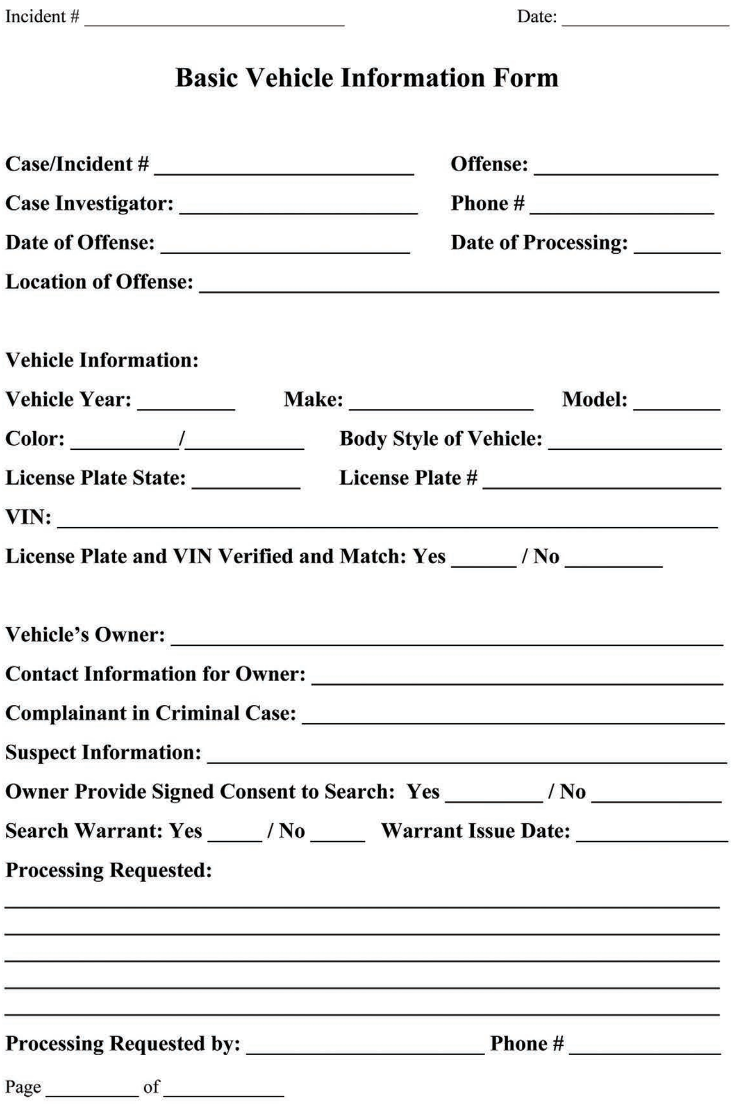

ALL OFFICERS
PLACE ALL VEHICLES ON CEMENT SLAB AREA ONLY
COMPLETE HPD VEHICLE COMPOUND ENVELOPE AND TAG IN LOCK BOX AT PROPERTY ROOM

Figure 3.3 Signage expressing important reminders to visitors is always valuable to dominantly post, including signs giving law enforcement officers and tow-truck drivers clear instructions. Be aware, even with clear signage, the instructions are not always followed like in this photograph.

Initial Steps before a Vehicle's Processing Begins

Once the vehicle has been admitted to the facility, the first task is to enter the vehicle into whatever system is tracking the progress of the vehicle through the facility. The next task is to begin double-checking the information placed on the vehicle submission form and reach out to the case investigator or whoever authorized the towing of the vehicle to the examination facility. The submission form shown in Figure 3.2 is completed by the officer bringing the vehicle into the facility. A new form, completed by the evidence technician will likely be filled out and much of the information from the officer's form will be copied or transferred over (Figure 3.4). One may feel that the copying of the information is an



Incident # ____________________ Date: ____________

Basic Vehicle Information Form

Case/Incident # ____________________ **Offense:** ______________
Case Investigator: __________________ **Phone #** ______________
Date of Offense: ___________________ **Date of Processing:** _______
Location of Offense: ____

Vehicle Information:
Vehicle Year: _______ **Make:** ______________ **Model:** _______
Color: _______/_______ **Body Style of Vehicle:** ______________
License Plate State: ________ **License Plate #** _________________
VIN: ____
License Plate and VIN Verified and Match: Yes _____ **/ No** _______

Vehicle's Owner: ____
Contact Information for Owner: ________________________________
Complainant in Criminal Case: _________________________________
Suspect Information: ____
Owner Provide Signed Consent to Search: Yes _______ **/ No** _________
Search Warrant: Yes _____ **/ No** _____ **Warrant Issue Date:** ___________
Processing Requested:
____
____
____
____
____

Processing Requested by: ___________________ **Phone #** ____________

Page _______ of _________

Figure 3.4 Each department will have their own set of processing documentation forms. This is an example of a summary-type form that covers the basic information about the vehicle being processed for evidence.

unnecessary redundancy. Although the two forms may be largely similar, they are completed by two different individuals for two different purposes. Consequently, the information should be documented in two different forms. In addition, the vehicle should be run through the state's vehicle registration database and have all identification and ownership information on the form verified for accuracy. Prior to contacting the case investigator, the evidence technician should confirm that the vehicle's keys are available and if not, see if the case investigator might be able to retrieve them. The vehicle can always be opened with a "Lock-Out Kit," but using keys to gain access to the vehicle is always preferred.

Contacting the case investigator should be a two-way conversation so that the evidence technician has a clear understanding of what the case investigator is needing from the vehicle's examination. The evidence technician and the case investigator can also work together to determine what is the priority in the processing. Things can change during the actual processing of the vehicle; therefore, keeping the lines of communication open with the investigator is a good idea. Of course, in small agencies where the case investigator and evidence technician are one and the same, then that point is unnecessary. In addition to determining the need for any keys to the vehicle, the evidence technician should do a cursory look around the vehicle just in case anything important stands out and needs to be discussed with the case investigator. The ownership or guardianship of the vehicle should be determined, and if the vehicle is going to be released, then who should be contacted to pick up the vehicle. Knowing the vehicle's owner is also important for determining and obtaining the legal authority is to access the car. The case investigator is typically tasked with getting a consent to search form signed by the owner or a search warrant signed by a judge.

Conducting a Legal Search

Any search of a vehicle, whether it is conducted by a sworn police investigator or a civilian crime scene investigator, must be conducted legally. The U.S. Constitution and the Fourth Amendment do not stop at the doors of a vehicle examination building. The Fourth Amendment protects citizens from unreasonable searches, but not necessarily from all searches. Specifically, the Fourth Amendment states the following:

> The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no warrants shall issue, but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.

The scope and meaning of the Fourth Amendment have been defined, clarified, and, at times, limited by its interpretation by the U.S. Supreme Court.

The reason for conducting a legal search of a vehicle or a search of anything for that matter is that an illegal search will lead to the inadmissibility of recovered evidence. Many have heard of the concept the "fruits of the poisonous tree" and the United States Supreme Court case: *Mapp v. Ohio* (1961). However, *Mapp v. Ohio* was not the first case that established that evidence recovered during an illegal search could not be used in court. Just short of 50 years earlier, the U.S. Supreme Court case of *Weeks v. United States* (1914) established that evidence recovered during an illegal search could not be used in federal courts.

For 47 years, state and local police officers who conducted illegal searches could still use their finds as evidence in state courts. It was not until Chief Justice Earl Warren's court (1953–1969) and the Supreme Court's ruling in *Mapp v. Ohio* that extended the *Weeks v. United States* ruling to the state court level of the judicial system. On May 23, 1957, three Cleveland police officers entered the home of Dollree Mapp and conducted an illegal search with a fictitious warrant. Police were looking for evidence related to a bombing that occurred earlier. The police did not find any evidence of the bombing but did find "obscene" material inside a trunk found in the basement. Ms. Mapp was charged with and found guilty of possession of obscene material. She appealed to the U.S. Supreme Court, and in a 6–3 opinion, her conviction was overturned. In the end, investigators and evidence technicians must remember if they pick fruit from the poisonous tree by conducting an illegal search, anything recovered during that search will not be admissible in a court of law.

Obtaining a search warrant is always the safest approach when it comes to searching the property of citizens. Search warrants are obtained by providing a judge or magistrate with probable cause of the offense committed and must identify the place to be searched (vehicle) and the evidence expected to be found in or on the vehicle. When search warrants are issued, they have a limit on how long the investigator has to search the location. The time limit is typically three days, in addition to the day the warrant was issued and one day to make the "return" back to the court. The warrant's "return" is a detailed list of everything seized from the vehicle by the investigator. The investigator should include every piece of evidence recovered, including the number of recorded photographs, lifted fingerprints, and recovered DNA samples. These items should be included on the warrant's return in addition to any physical or tangible evidence removed from the vehicle.

The Fourth Amendment declares that a warrant is needed to conduct a search and seize an individual's property. However, the courts have established six exceptions to the warrant requirement of the Fourth Amendment, and they are as follows:

- A need to prevent immediate loss or destruction of evidence
- A search made by consent of involved and present parties
- Plain view/plain touch (pat down)
- Abandoned property/property open to public
- Existence of exigent circumstances
- A search of a person or property within the immediate control of the person, incident to a lawful arrest

For law enforcement officers patrolling the street, they are aware of the exceptions to the warrant requirement when it comes to searching vehicles stopped during a traffic stop because of the first listed exception: a need to prevent immediate loss or destruction of evidence. Because vehicles offer the operator the ability to drive away and destroy potential evidence, the law enforcement officer is not always required to always obtain a warrant during a routine traffic stop. For example, if an officer stops a driver for speeding and detects the odor of freshly burning marijuana (or other clear and evident wrongdoing), the officer is authorized to remove the driver from the vehicle and search the vehicle for the illegal substance. On the other hand, that same officer who smells burning marijuana coming from a private home cannot remove the occupants and search the home without first obtaining a warrant. The difference being that a vehicle offers a greater chance for the "immediate loss or destruction of evidence" and as such, law enforcement officers have the ability to search vehicles in specific circumstances without a warrant. However, the "immediate loss or destruction of evidence" exception to the warrant requirement does not apply to anyone working in a vehicle examination building. Once a vehicle has been "seized," the threat of the immediate loss of evidence is over and a search warrant must be obtained.

When it comes to vehicle searches, the most common exception to the warrant requirement is to obtain the consent of the owner or operator of the motor vehicle. Consents to search are most often obtained in the cases when a victim's vehicle is needing processing. Victims and complainants are typically willing to allow investigators to process their vehicles for evidence. Suspect vehicles, on the other hand, may require investigators to seek a search warrant. Although verbal consents to search are accepted in courts of law, they can be challenged and eventually come down to the investigator's word against the vehicle's owner. The most effective way to obtain someone's consent to search their vehicle is to obtain a signed consent to search (Figure 3.5). Every agency will have their own preformatted consent to search forms, but all these different forms will have the following core information:

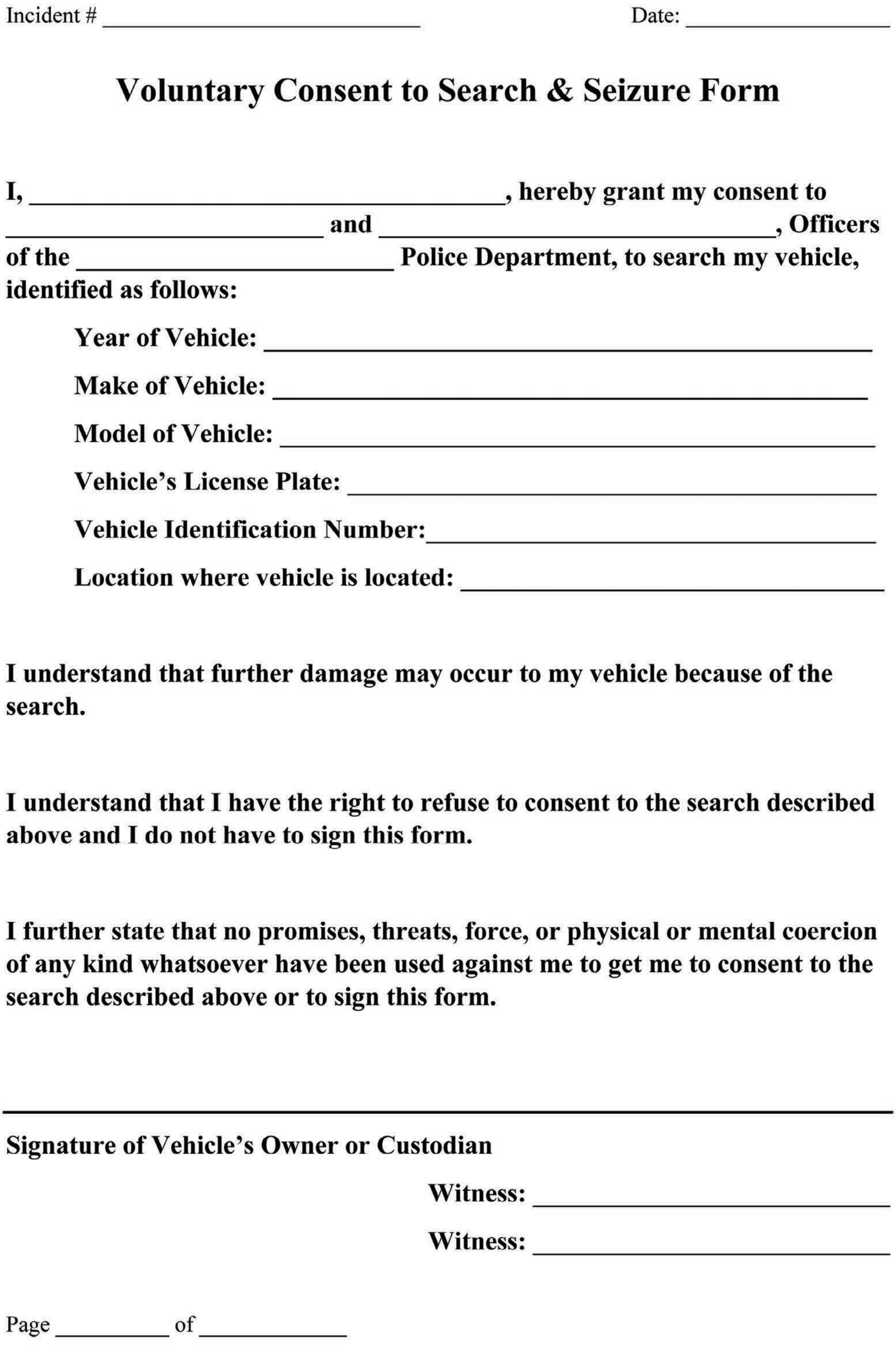
- Identity of the person giving authorization for the search
- Identity of the person or persons conducting the search
- Identity of the property to be searched
- Statement that the consent has been given completely voluntarily

The person giving authorization for the search should be the owner but may be the person who has "care, custody, and control" of the vehicle. For example, a father may have bought a car for their 18-year-old daughter, but the car is registered under his name. However, the vehicle is in full care, custody, and control of the daughter and she is able to consent to a search.

Of primary importance, any consent must be completely voluntary and some sort of written statement of such voluntary consent should be on the consent to search form. The U.S. Supreme Court ruled in *Schneckloth v. Bustamonte* (1973) that consents to search must be made voluntarily and that the determination of the voluntariness is based on the totality of the circumstances. In order to ensure the voluntary consent, an investigator may use something similar to the following statement on their consent form:

> I understand that I have the right to refuse to consent to the search described above and to not have to sign this form. I further state that no promises, threats, force, or physical or mental coercion of any kind whatsoever have been used against me to get me to consent to the search described above or to sign this form.

Remember that coercion can be interpreted by the court; therefore, investigators should not imply any type of promise or threat when obtaining a signature. For example, an individual may ask an investigator, "What happens if I do not sign the form?" An investigator should never say that they "will go get a warrant" or they "will search the car anyway." Any statement of what the investigator's next step could possibly be interpreted as a threat. Therefore, the best response to any similar type of questions should be in the



Incident # ____________________ Date: ______________

Voluntary Consent to Search & Seizure Form

I, ____________________, hereby grant my consent to ____________________ and ____________________, Officers of the ____________________ Police Department, to search my vehicle, identified as follows:

Year of Vehicle: ____________________

Make of Vehicle: ____________________

Model of Vehicle: ____________________

Vehicle's License Plate: ____________________

Vehicle Identification Number: ____________________

Location where vehicle is located: ____________________

I understand that further damage may occur to my vehicle because of the search.

I understand that I have the right to refuse to consent to the search described above and I do not have to sign this form.

I further state that no promises, threats, force, or physical or mental coercion of any kind whatsoever have been used against me to get me to consent to the search described above or to sign this form.

____

Signature of Vehicle's Owner or Custodian

Witness: ____________________

Witness: ____________________

Page ________ of ________

Figure 3.5 A consent to search form should identify who is authorizing the search, who will be conducting the search, what is going to be searched, and some sort of statement stating that the form is voluntarily given without any form of coercion.

arena of “we will cross that bridge when we come to it” or “we will make a decision at a later time.” What the investigator should try to avoid is any impression of coercion or intimidation.

The second criterion for a valid consent to search is that the person signing the form has the authority (care, custody, and control) over the vehicle or area to be searched. Therefore, the investigator should ascertain the signer’s authority to grant a valid consent. The consent to search should be signed by both the investigator and the owner of the vehicle. Some agencies like to have a witness sign the form as well. Preferably, the witness would be a citizen and not another law enforcement officer. The final recommendations for consent to search forms should be to have the case or incident number, as well as the date and time the consent was signed printed on the form somewhere. Because of the mess that fingerprint processing of vehicles can cause and the damage that can arise from removing fired projectiles from a vehicle, the investigator should verbally, if not placed in writing on the consent form, that investigators may cause additional damage to the vehicle during its processing.

The “Plain View” exception to the warrant requirement is something that should not be routinely used by crime scene investigators working in the controlled environment of a vehicle examination building. Even if a piece of contraband is plainly visible in the vehicle, the plain view exception does not extend to other portions of the vehicle and simply recovering one or two items that are in plain view does not necessarily equate to a full and thorough investigation. It is always best to work with a consent or a warrant. The rule of thumb should always be to err on the side of caution or in other words, when in doubt, get a warrant.

There is an “Exigent Circumstances” exception to the warrant requirement, and as stated earlier, once a vehicle is secured at a police facility, then exigent or emergency circumstances no longer apply. At one time, investigators equated exigent circumstances with the seriousness of murder investigations, and when law enforcement officers wanted to search property related to a murder investigation, then the exigent circumstances’ exceptions were claimed and searches were conducted without a warrant. In 1978, that concept came to a crashing end with the U.S. Supreme Court decision in *Mincey v. Arizona*. On October 28, 1974, Officer Barry Headricks of the Tucson Police Department was conducting a narcotics investigation at the home of Rufus Mincey. In the course of the arrest, Mr. Mincey shot and killed Officer Headricks. Homicide investigators completed a complete search of Mr. Mincey’s apartment. The search lasted 4 days. Mr. Mincey was found guilty and appealed to the Arizona Supreme Court on the grounds of an illegal search. The Arizona Supreme Court upheld the conviction and declared there was a “murder scene exception” to the warrant requirement of the Fourth Amendment. Mr. Mincey appealed to the U.S. Supreme Court, and the Arizona Supreme Court asked that the U.S. Supreme Court include a “murder scene exception” to the list of exceptions to the warrant requirement. In an 8 to 1 decision, the U.S. Supreme Court completely rejected the lower court’s request and overturned the conviction. Justice William Rehnquist was the only dissenting opinion. Justice Potter Steward wrote the court’s majority opinion and succinctly stated that the seriousness of an offense does not in itself create exigent circumstances. Therefore, when searching a vehicle involved in a homicide investigation, it is always best to obtain a warrant for a vehicle. Although it is always best to obtain a warrant, if the one and only registered owner of a vehicle dies in the vehicle, then the decedent no longer has privacy rights. In addition, a reasonable and prudent person would believe that the deceased would want to know how and why they died. If a suspect is identified by something found in the victim's car, the suspect is not allowed to claim the privacy rights of the deceased based on the Fourth Amendment. In the end, when in doubt, obtain a warrant.

General Progression of a Vehicle's Processing for Evidence

At the start of a vehicle's processing, an investigator should gather all their supplies and tools that they will need to complete the vehicle's examination. This includes gathering all the forms and papers necessary to record notes about the investigation. One's camera and flash should have fully charged batteries and confirm that a cleared memory card is installed in the camera. In addition to camera batteries, the investigator's flashlight(s) should also have fresh batteries or be fully charged. Depending on what the evidence technician has been asked to process on the vehicle, they should gather all the necessary fingerprinting, DNA collection, trajectory equipment, etc., and have them readily accessible for the vehicle's processing. This is also where having a rolling cart of some sort is extremely valuable. It provides the investigator an area to stage all their equipment and easily move it around the vehicle as it is being processed.

Now that the evidence technician has the legal right to search a vehicle, they have a clear understanding of what has been requested regarding the vehicle and have their equipment ready to begin the examination, then it is time to start the vehicle's processing. The processing of a vehicle should begin by positively identifying it. License plates can be easily changed. Therefore, the identification of the vehicle should be completed through the vehicle identification number (VIN). The VIN is the vehicle's individual serial number. Since 1981, VINs have been 17 digits in length and the individual digits have a specific meaning to each individual vehicle. The evidence technician should examine the VIN plate located on the top left (driver's side) surface of the dashboard, along the bottom edge of the windshield. The VIN plate should be compared to the VIN sticker that is located on the driver's door jamb or "B" pillar. If an investigator is concerned that the VIN plates do not appear original or that they have been altered, then there are other places on the vehicle that one may look on the vehicle for additional VINs or partial VINs, including the following locations (Figure 3.6):

- Firewall, which separates the engine from the passenger's compartment
- Radiator's support bracket
- Front part of the engine
- Wheel arch on the front left side of the vehicle
- Steering column
- Glovebox
- Major components on the vehicle
- Metal frame of the vehicle

Vehicle identification numbers, whether complete or in part, are located in numerous locations on the vehicle. Some of the locations may be difficult to access without removing pieces of the vehicle, but it is important that the true identification of the vehicle is made via the VIN.

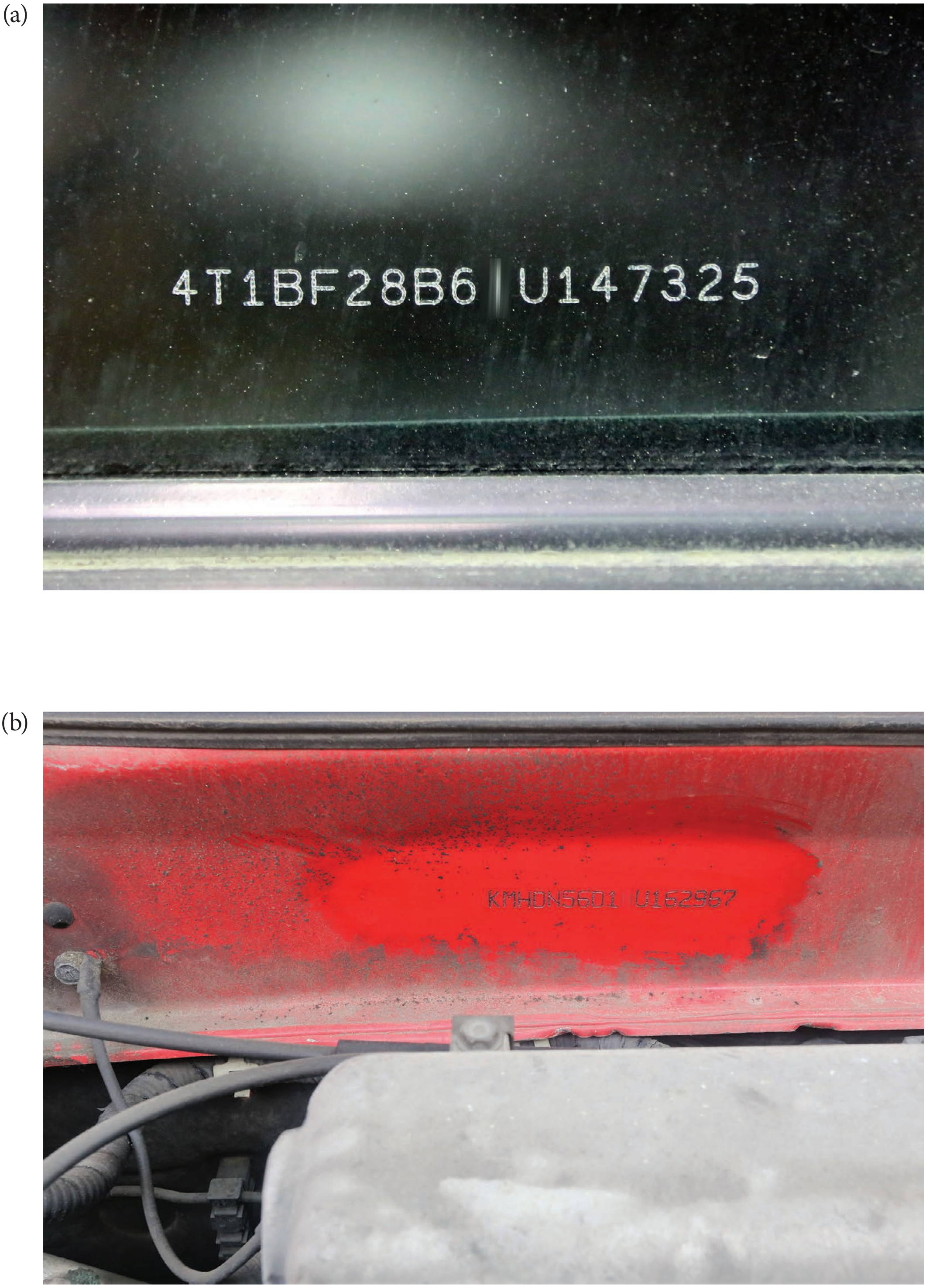


Figure 3.6 Most investigators are aware of the vehicle identification numbers (VINs) located on the dashboard and the driver's side "B" pillar, but there are other locations that can be examined to verify the vehicle's unique identifiers. Some manufacturers will engrave the VIN (a) on the passenger door windows or (b) on the firewall at the back of the engine.

(c)

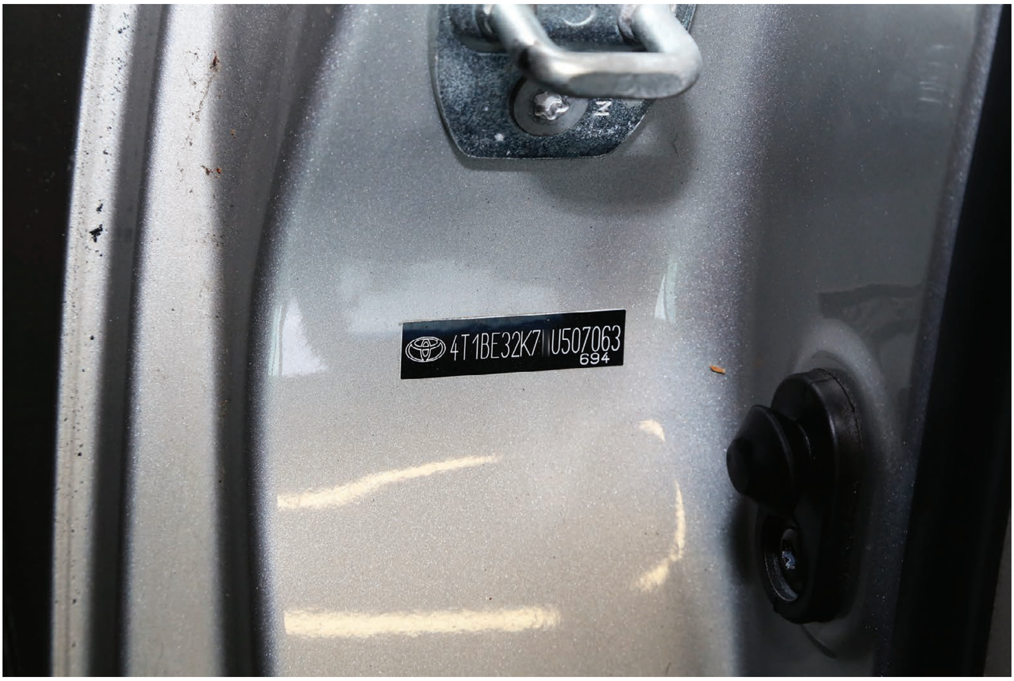


Figure 3.6 (Continued) (c) Major body components may also have stickers or engraved numbering that offers a full or partial VIN, like this one found on the back driver's side door frame.

Since 1981, the individual digits and their position along the VIN have very specific meanings. The VIN can be broken down and deciphered as follows:

- First digit identifies the vehicle's country of origin.
- Second digit identifies the manufacturer and is the first letter of the manufacturer's name.
- Third digit identifies the vehicle's style or manufacturer's division.
- Fourth to eighth digits identify the vehicle's model, body type, restraint system, transmission, and engine types.
- Ninth digit is a check digit to distinguish possible fraudulent VINs.
- Tenth digit identifies the vehicle's model year.
- 11th digit identifies the manufacturing plant where the vehicle was assembled.
- 12th–17th digits are the "production sequence numbers," which differentiate the numerous vehicles that were built to similar specifications.

The specific codes for things like manufacturer's assembly plant and engine type can be easily determined through "VIN Decoders" available through the Internet. However, the most commonly used piece of information extracted from the VIN, beyond the unique production sequence number, is the model year of the vehicle (VIN's tenth digit). The VIN plate that is located on the "B" pillar of the driver's door jamb will also have the month and year that the vehicle was assembled. However, the year the vehicle was assembled may not be the actual model year of the vehicle. Vehicles made late in the year may actually be the following year's model. As a result, evidence technicians should identify the model year of the vehicle as determined by the tenth digit of the VIN and not necessarily the date stamped on the driver's door jamb VIN plate. The tenth digit can be decoded as follows:

- 1981–2000: the alphabet starting with "B" (1981) through Y (2000) was used. The letters I, O, Q, U, and Z were not used.
- 2001–2009: the numbers 1 through 9 corresponding to the model year were used.
- 2010–2030: the alphabet will be used as earlier, with "A" meaning the vehicle is a 2010 model. The letters I, O, Q, U, and Z will not be used again.

If the vehicle's VIN is questionable, the evidence technician may have to decide whether they should start digging around inside the vehicle to locate one of the other VIN plates on the vehicle. Sometimes, verifying a VIN may have to wait until after the processing of vehicles, especially for latent print or Touch DNA evidence. The investigator is constantly having to make choices during a vehicle's processing, including the order of processes and even choosing between two processes, attempting to identify which one will produce the most likely and most positive result.

The vehicle's VIN and other unique identifiers are recorded in the investigator's notes. Whether those are preformatted forms or just recorded on blank paper, the written documentation of the vehicle is imperative to a quality investigation. No one can simply remember all the specific details of a vehicle and the evidence recovered from it, especially when an investigator is tasked with processing multiple vehicles every week. A written record of the vehicle and the steps taken during its processing are required to ensure that all recovered evidence is admissible in a court of law. Individual crime scene investigators will have their own system or preformatted forms that they use to record notes during a scene or vehicle examination. Blank paper is perfectly acceptable, but having one's own set of preformatted forms simply helps to ensure that small details about the vehicle are not forgotten. Forms of this type are presented in more detail in Chapter 4. The different forms discussed can be used in whole or in part and incorporated into what an investigator is already working with.

The first notes recorded will likely be the vehicle's basic identification information, including its unique identifiers like the license plate and VIN. After this basic information is recorded, the investigator should walk around the vehicle and notate all the damage, missing parts, and specific features of the vehicle, like the type of wheels to any unique paint job the vehicle may have. Remember that the documentation of damage and condition of the vehicle's exterior is not simply about the case investigation but also to protect the investigator from false claims of damage after the vehicle is returned to the owner. Notes are always supported by photographic documentation. The vehicle should be thoroughly photographed all the way around, and if the investigator has a rolling step-ladder, then the vehicle should be photographed from above as well. These photographs can be considered as "In-situ" or "as-is" photographs and represent the condition of the vehicle as it was received by the vehicle examination facility. As is common with most crime scenes, the investigator works from the outside in and, to be clear, a vehicle is a crime scene, it is just a crime scene on wheels. Therefore, the investigator must avoid jumping inside a car and grabbing a piece of evidence in plain view. The evidence will not be going anywhere. Maintain a methodical approach, working from the outside of the vehicle and then move into the vehicle's interior.

When recording notes and eventually writing the offense report, an investigator must be clear about the vehicle and the parts of the vehicle. The front and rear of a vehicle are fairly self-explanatory, but what about right from left? Crime scene investigators are used to avoiding the terms right and left instead of relating everything to a compass rose. Unfortunately, one cannot use the same technique with a vehicle that has been removed from the scene. Therefore, when looking at a vehicle, the left and right sides are determined by the driver's point of view. A second option is to refer to the left side of a vehicle as the driver's side and the right side of a vehicle as the passenger's side. However, it is awkward to refer to the quarter panels, which are located at the vehicle's four corners, as the driver's side front quarter panel or the passenger's side rear quarter panel. It is much more common to refer to the quarter panels as the left front quarter panel or the right rear quarter panel. A vehicle's side doors are also better described using the right and left monikers. The driver's door is clear and concise, but stating the driver's side rear door is not as clear as describing it as the left rear passenger's door. Whatever naming convention one uses, it should be clear, consistent, and does not confuse the reader. Most individuals can figure out the difference between a vehicle's front windshield and its back window. However, the vehicle's support pillars may not be as well known. The support pillars are common areas for latent fingerprints and bullet strikes and need to be identified correctly in reports. These pillars separate the main parts of the vehicle from the roof, and they are the roof's support. The pillars are identified as "A," "B," and "C" pillars, with the "A" pillar closest to the front and "C" pillars to the rear. Vehicles come in a variety of designs and may have only three pillars (A, B, and C), while others may have more as seen in the extended passenger van depicted in Figure 3.7. In general, maintain a clear and descriptive identification of all parts of the vehicle where evidence is found or has impacted.

Once the overall documentation is complete, investigators can move on to the recovery of evidence from the automobile. The most common request by detectives is for evidence processors to process vehicles for "prints and DNA." The decision as to which process is completed first is up to the investigator. In the broad scope of things, the better choice is likely to recover DNA swabbing samples first and then to process the vehicle for fingerprints

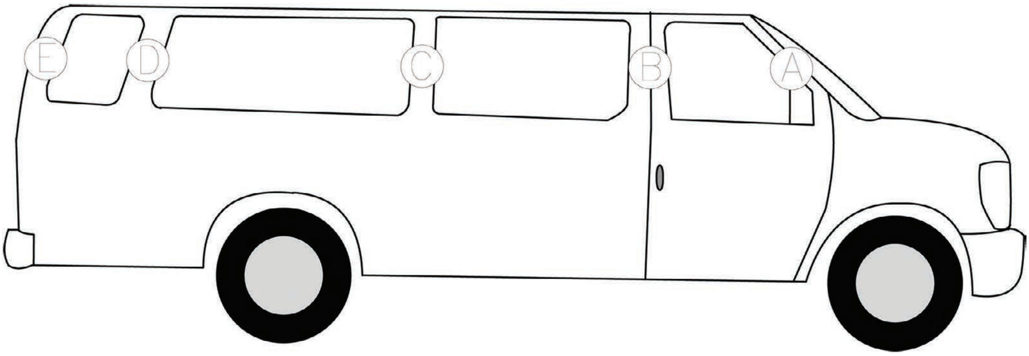


Figure 3.7 Providing a clear written picture of the vehicle will help readers of a written report be able to follow the investigator's train of thought as they detail the important aspects of the vehicle. The consistent use of terminology is also imperative in report writing. For example, identifying a vehicle's body parts correctly assists with providing clarity to one's written report. The identification of a vehicle's support pillars begins with the forward-most structural support for the vehicle's frame (A), and each support is labeled until the last vertical support structure at the rear of the vehicle (E) is reached.

second. This is because the processing of DNA is typically done by swabbing very specific areas of a vehicle, whereas fingerprint processing is a more widespread examination of the vehicle. The decision of which process to complete first may also be based on the type of surface one is looking at. Deeply textured surfaces are much more likely to contain DNA evidence than identifiable fingerprint evidence. On the other hand, DNA recovery from an exterior door handle may be requested, but the door handle has a smooth metal surface, and oblique lighting indicates that a latent fingerprint is present. The investigator may choose to lift the latent fingerprint first and can always swab for DNA on the door handle afterward. Therefore, the decision of what order evidence recovery tasks are completed is going to be different from vehicle to vehicle, depending on the condition of the vehicle, the type of surface, and what kind of information investigators may have regarding the criminal act, like if the suspects wore gloves or not. Gloves may prevent fingerprints from depositing, but DNA evidence may still be viable. Vehicles may require other processes, such as tracking ballistics or documenting bloodstain evidence. Anything that is going to involve detailed documentation and repeated contact with the vehicle should be completed after the collection of fingerprint and DNA evidence.

Once the exterior of the vehicle is processed for DNA and fingerprints, the inside of the vehicle can be worked on. The investigator will have to return to their note pages recording the information about the condition of the vehicle. The interior of the vehicle also needs to be documented and some of that can be completed by looking through the windows, but any closer observations of damage and the locations of evidence should be recorded at this time. The contents of the vehicle are also documented. After the exterior's documentation, including photography, is completed, the vehicle's interior is processed. The evidence technician should process the vehicle for evidence, beginning with the least intrusive process first and working toward the more destructive processes. For example, fingerprints and DNA can be sought for first and then the removal of door panels and cutting into seats in order to track and remove bullets that were fired into the vehicle. Sometimes during the processing of the vehicle, especially in shooting incidents, the investigator will be somewhat destructive, and additional damage to the vehicle will be sustained. An investigator should try and protect a victim's property by removing screws and retaining clips that are holding trim pieces to the vehicle, instead of using a prybar or cutting device. Furthermore, any screws and retaining clips should be placed in a bag and left together inside the vehicle for the complainant or owner. There will be times when a piece of evidence will have to be cut out of a vehicle and the investigator should document those actions and not try to hide from the damage created.

The methodology for searching and processing vehicles for evidence always begins with the least destructive process first and then moves to the more destructive processes. Therefore, documentation and the recording of visual observations are first and moves through the minimally damaging processes such as fingerprint processing and can conclude with arguably the most destructive process done by evidence technicians and that is the recovery of ballistic evidence from the vehicle. Investigators will develop a natural pattern to their processing and examination efforts over time. But these efforts should maintain an overall consistent and similar manner to ensure that a complete and thorough examination is achieved and that nothing is missed during the vehicle's inspection. Investigators should also remember that while processing, if a new piece of previously undiscovered evidence is located, then the investigator needs to step back and begin all anew with that single item. This would require making handwritten notations and recording a new set of evidentiary photographs. If the investigator is completing a scale diagram of the vehicle, then measurements will also need to be recorded. Once the newly discovered evidence is caught up with the rest of the vehicle's examination, then the investigator can move on to the next step, which is the recovery and packaging of evidence.

Processing Vehicles for Unique Types of Evidence

Crime scene investigators must be prepared to recover almost any kind of object or process for any kind of evidence at crime scenes. Vehicles are no different than a crime scene in the field, but they do have the benefit of being processed in a more controlled environment. Investigators should take advantage of this opportunity. One type of vehicle that will frequently enter the facility will be one from a hit-and-run investigation. Typically, accident or crash investigation units handle hit-and-run investigations, also known as "Fail to Stop" and Render Aid (FSRA) or Fail to Stop and Give Information (FSGI). However, not every agency will have an investigator specifically assigned to process vehicles involved in a hit-and-run investigation or the hit-and-run incident was not an "accident," but rather it was intentional, which changes the agency's investigative division's responsibility. There are a couple of common requests made when processing hit-and-run vehicles, and they revolve around the need to identify what came into contact with the said car, whether it was another car, object, or a human being.

When two vehicles impact each other, there is generally an exchange of paint between the two vehicles. Thanks to Edmund Locard's "Theory of Exchange," which states "Every contact leaves a trace" dictates that there will be a transfer of material between the two contacting surfaces. Recovering the paint or debris left behind is the job of the evidence technician. Removing debris and paint from a vehicle is typically done by scraping the material with a sterile surgical blade or a knife that has been thoroughly wiped down with isopropyl alcohol. Paint transfers from minor impacts may not come off as easily with just a surgical blade or scalpel. However, this does not preclude the investigator from recovering such evidence. More severe impacts likely will cause a vehicle's paint to crack and is much easier to scrape off. Whichever tool is chosen to scrape the material or unknown paint from the vehicle, the unknown paint or debris is scraped into an evidence envelope or a druggist fold envelope for collection. Paint chips have a tendency to chip away at odd angles. Therefore, investigators should be cognizant of that possibility and keep the scraping action or force downward, so that all material is going to be pushed or fall into the evidence envelope that is held just below the area being scraped. Eventually, the envelope will be sealed and marked with the case information. If the unknown paint transfer was scraped from the examined vehicle's own painted surface, investigators should also collect a known paint sample of the vehicle being examined and from the same surface, but away from the damaged portion of the automobile. The collected sample should be approximately the size of a United States quarter. As far as the unknown paint or debris collected, it is recommended to collect as much of the foreign material as possible. One does not need to stuff an evidence envelope full of material, but no one is going to complain if "too much" evidence is collected.

Another type of hit-and-run accident that sadly is all too common are vehicle-pedestrian or vehicle-bicycle hit-and-run crashes. If a suspect vehicle is brought into an examination facility, it is up to the evidence technician to find traces of the victim on the vehicle. Depending on where the impact was on the vehicle, it may be necessary to have the vehicle lifted on the car lift and to look on the vehicle's undercarriage for trace fibers, DNA, or other pieces of evidence. Fiber evidence can be collected and placed into a druggist fold or glassine envelope. A suspect may wash the exterior of the vehicle but may forget to do the unseen areas underneath the vehicle, stuck in the radiator's front cooling fins, or behind the grill or other trim pieces (Figure 3.8). If the vehicle has been cleaned by the suspect, what remains maybe just a single fiber or two. If the victim was run over, the

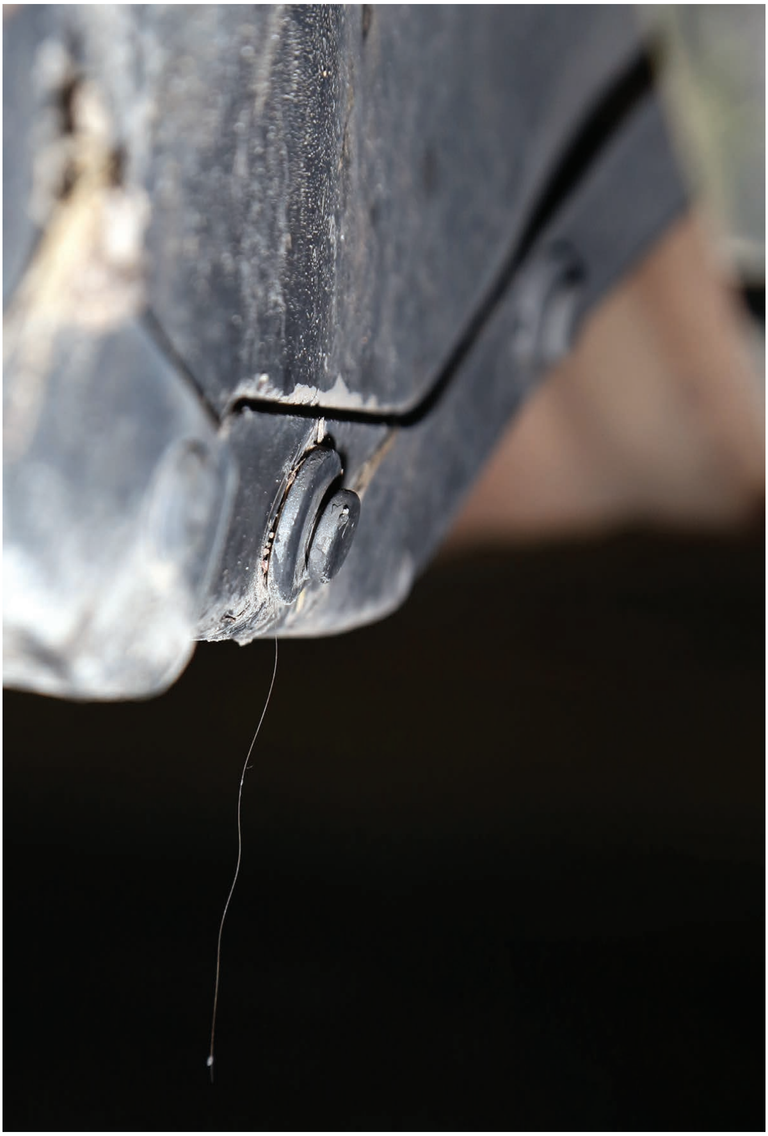


Figure 3.8 Evidence from a hit-and-run can be extremely small, especially if the vehicle belongs to the suspect and it has been washed. This photograph shows a single hair from a hit-and-run victim hanging from underneath one of the vehicle's wheel wells.

undercarriage of a vehicle should be thoroughly examined and special attention paid to any swipe marks visible through the grime commonly found on the undersides of vehicles. Even if no physical evidence is located underneath a vehicle, any swipe marks observed on the vehicle should be photographed and fully documented. It may be circumstantial evidence, but the evidence is evidence. Blood, tissue, and other serological evidence can be collected through the swabbing technique detailed in Chapter 7.

Another common task requested during crash investigations is determining the identity of the driver or the positions of passengers at the time of a collision. Investigations should search for and recover any bloodstains found inside the vehicle. If bloodstains, hair, or tissue is not found, then the investigator should collect Touch DNA swabbing samples from the vehicle controls, seatbelt straps, and any deployed airbags. Airbags generally deploy with such force that bloodstains or other body fluids are commonly found. The advantage of recovering DNA from airbags is that it places a time stamp on when the individual came into contact with the airbag.

In the course of vehicle crashes, pieces of a vehicle may be left behind at the scene of a crime. Any vehicle glass, plastic, or other parts left behind at the crime scene should be collected. The damaged pieces hold a great deal of information, including the make and date of manufacture for a vehicle. Furthermore, if just a portion of something is left behind at the scene, then it is possible to make a fracture match between the two pieces. Consequently, when a suspect's vehicle arrives at a vehicle examination facility, which has damaged trim and/or glass, these items should be examined closely. Vehicle examiners should remove any damaged parts of the vehicle so that any potential fracture matches can be made between the debris left behind at the crime scene and the remaining pieces left on the vehicle (Figure 3.9). Car parts and window glass all have part numbers stamped or printed on them somewhere. Therefore, even if the car was repaired, one may be able to compare part numbers, date codes, and determine if the vehicle had been repaired. For example, if a taillight assembly was damaged at a scene, but repaired by the suspect prior to the vehicle being seized, the examiner may be able to show that the vehicle's model year and the repaired part's manufacturing year are different (Figure 3.10). Because of how vehicles are manufactured, parts are generally date coded within 30 days of the vehicle's assembly date. Some of the manufactured dates will not be as clear as a numbered date but will be printed in a code. This is especially true with car window glass. Date codes on windows can be a unique arrangement of letters, numbers, and even through small dots placed next to letters on the information printed on each window (Figure 3.11). There is no standard between manufacturers as to the date coding of window glass or vehicle parts. Some of this coded information may be deciphered through an Internet search, but others might require contacting the manufacturer for decoding of the information.

Burned vehicles, whether accidental or intentional, is another unique type of investigation that requires a whole new set of investigative skills. Arson investigators are commonly cross-trained in fire and police investigations and many times will take the lead during the examination of burned vehicles. They will look at a burned vehicle and attempt to determine the cause and origin of the fire. Fire science and the determination of the cause and origins of fire are well beyond the scope of this book. However, there are a few tasks an evidence technician can do to assist arson investigators. One is to positively identify the vehicle through VIN plates remaining on the vehicle (Figure 3.12). As with every investigation, the photographer should thoroughly document the vehicle with photographs, especially in the area where the most fire damage occurred. The origin of the fire is generally the location

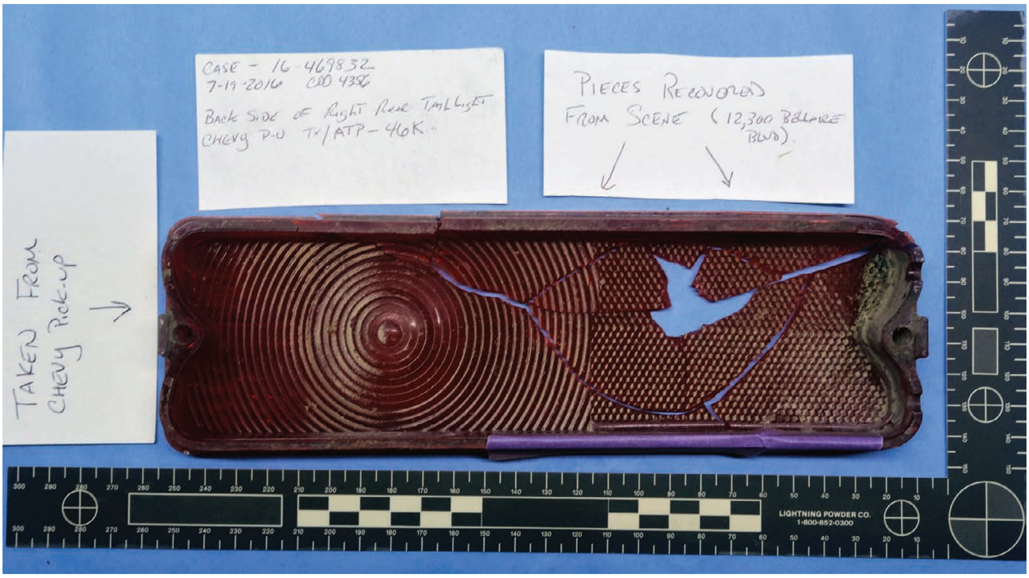

CASE - 16-469832
7-19-2016 CDD 4386
Back Side of Right Rear Taillight
Chevy P-U TX/ATP-46K
Pieces Recovered From Scene (12,300 Bellaire Blvd)
Taken From Chevy Pick-up
LIGHTNING POWDER CO.
1-800-852-0300

Figure 3.9 In the course of committing an aggravated robbery, the suspect's vehicle was damaged, leaving a piece of the taillight assembly behind at the crime scene. When the vehicle was located, the damaged taillight was removed and a fracture match was made between the portion of the light recovered from the vehicle and the pieces recovered at the crime scene.

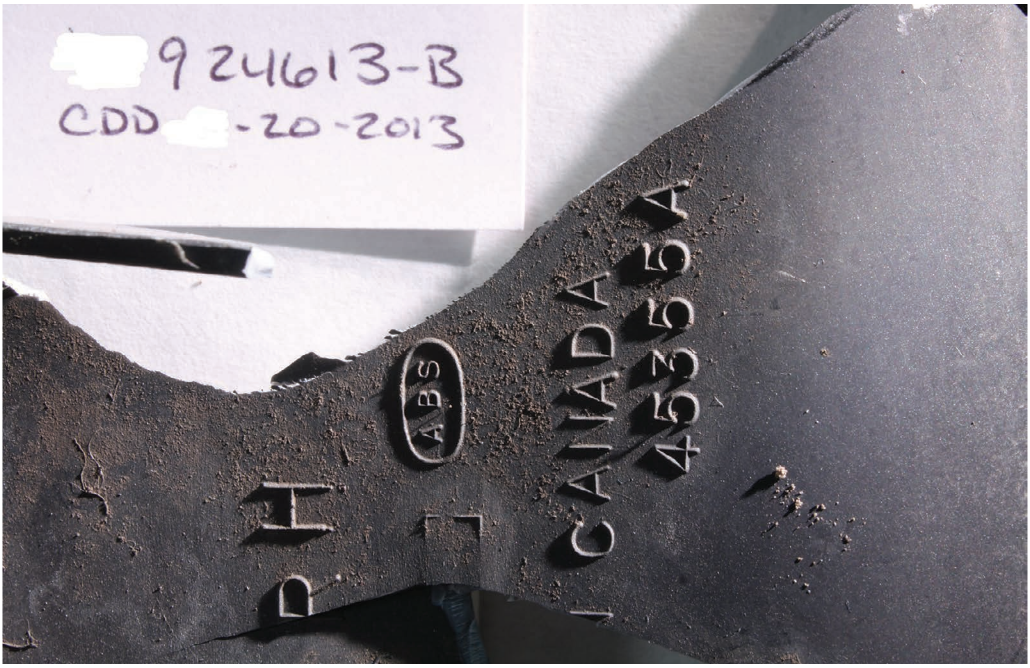

[redacted] 924613-B
CDD [redacted]-20-2013
PH
ABS
CANADA
453554

Figure 3.10 Most every part of a vehicle will possess some sort of part code and larger parts of the vehicle will possess additional information, like make, model, and date of manufacture. Comparing this information might give an indication if any repairs had been made to the vehicle at some point.

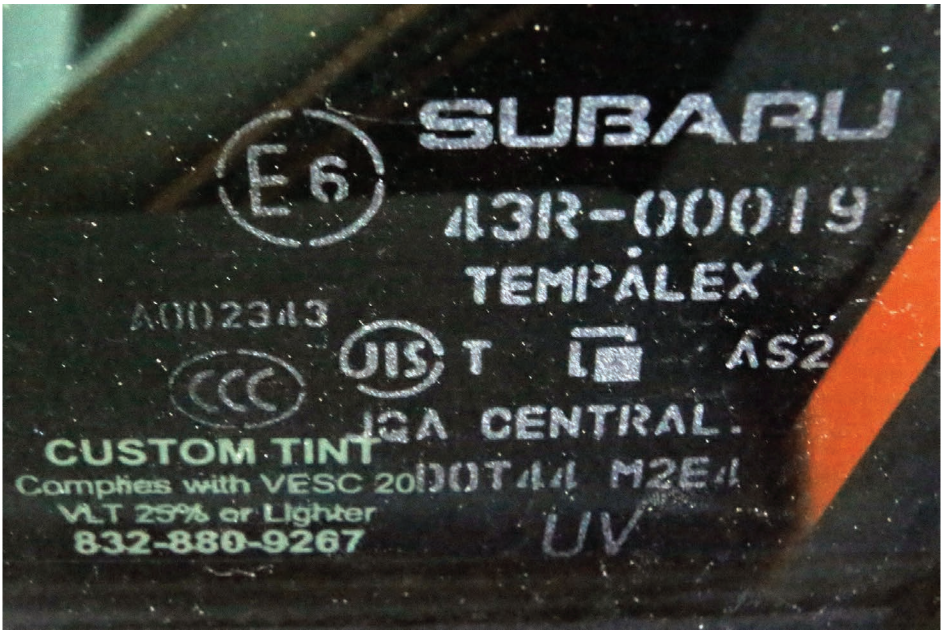

SUBARU
E6
43R-00019
TEMPALEX
A002343
JIS T AS2
CCC
QA CENTRAL
CUSTOM TINT
Complies with VESC 20
DOT44 M2E4
VLT 25% or Lighter
832-880-9267
UV

Figure 3.11 Every vehicle's original glass window will have a coded manufacturer's date and other information printed on it. This information can possibly tell an examiner if the window is a replacement or it is original to the vehicle. The coding on window glass is unique in that the combination of numbers and the little dots next to the text identify manufactured date, such as the small dot above the letter "A" in the word "TEMPALEX" found in this photograph.

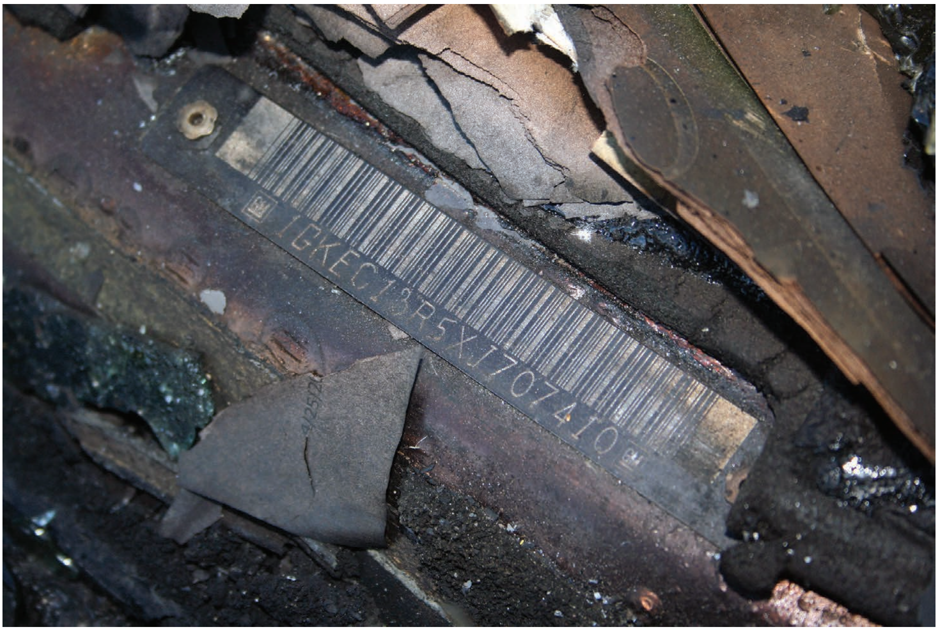

1GKEC13R5XJ707410

Figure 3.12 Arson investigators can determine the cause and origin of a fire, but vehicle examiners can help positively identify the vehicle, especially vehicles that were completely decimated by fire and reduced to bare metal.

where the most fire damage is found because the fire had more time to burn. The cause may be found by locating the source of ignition or telltale signs of an accelerant being used in the car. Many accidental fires will start in the engine compartment and spread from there. If a fire started anywhere else, the arson investigator will look carefully for any signs that an accelerant was used, such as a gas can or a burn trail leading away from the vehicle at the recovery scene. The crime scene investigator or evidence technician should follow along with the arson investigator and photograph all key aspects of the investigation.

The interior of severely burned vehicles will have to be sifted through very carefully to look for evidence and even for deceased bodies. One must be cognizant of what fire can do to objects and to human bodies. Fire will burn off much evidence, but others will take on different forms. For example, plastic gas cans may melt and be found as charred-red disks of plastic instead of their original container shape. Bodies can be burned away similarly and extremely hot fires can turn a body into hundreds of calcined bone fragments that are extremely delicate and must be recovered with extreme care. Having a forensic anthropologist would be extremely helpful when a burned body is located. They can be enormously helpful in recognizing osseous matter and may even be able to identify bone trauma that might give an indication as to the fire victim's cause of death. Investigating crimes and especially crimes involving fire is definitely a team effort and any help offered to an evidence technician should be welcomed. Sifting through a burned vehicle is done by sifting through layers of debris found in the car. This can be done by using a small brush and a dustpan and by removing debris from the vehicle a little at a time. In this way, one will be less likely to miss a small piece of evidence, like a melted fired bullet. Do not forget to photograph as the search progresses through the various layers of debris (Figure 3.13).

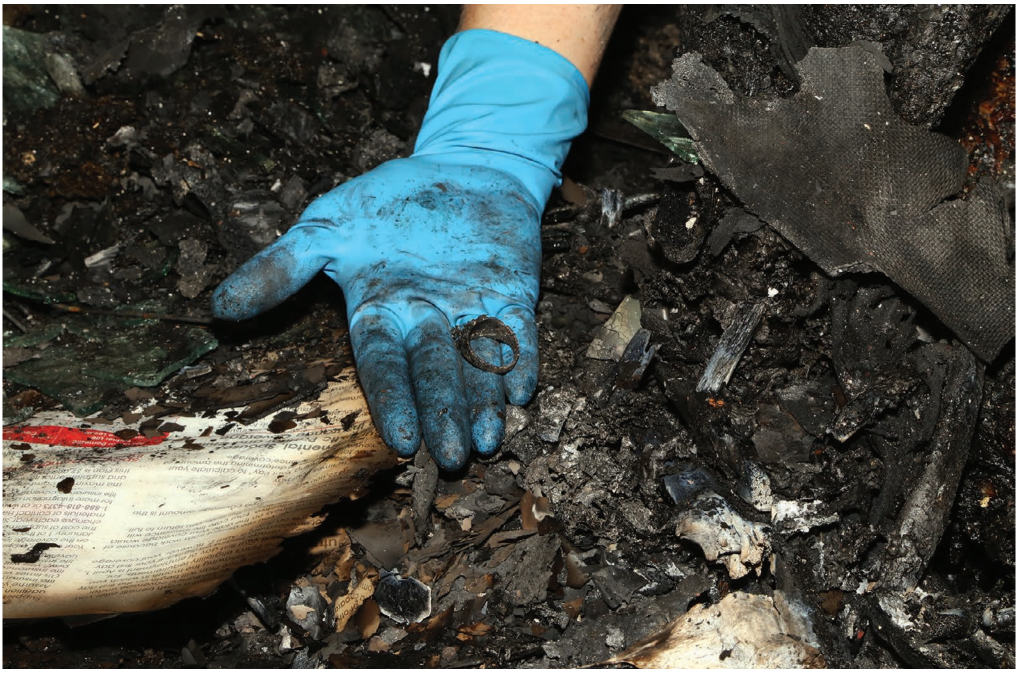


Figure 3.13 Extremely hot fires can reduce a body to calcined bone, which is extremely fragile and needs to be recovered with extreme care. One needs to search through a vehicle's contents carefully, by sifting through the vehicle and moving from the top layers of debris down.

Package any evidence, taking into special note exactly where each item was found. The arson investigator will likely take care, custody, and control of any arson evidence, while the forensic anthropologist will take responsibility for any human remains. Everything else of value will be the responsibility of the evidence technician.

Recovery and Packaging of Evidence

If one thought the recording of notes and writing reports seems redundant, then they will really not like the packaging of evidence. Much of police work is tedious, with relentless writing and documentation filling one's day. Of course, that part of the crime scene and criminal investigations is never shown on television. For those investigators who are able to keep a logical progression to their processing and evidence packaging, they will be greatly rewarded by the grateful appreciation of case investigators, laboratory personnel, and prosecutors. Maintaining the chain of custody is the name of the game in packaging evidence. Some of the important points that will be discussed are maintaining consistent identification of the evidence, using the proper packaging materials, and placing all the case information across each and every level of packaging.

Selecting the proper packaging can be the difference between property having value as evidence or not. The first selection in packaging is choosing between paper and plastic. There are specially designed containers for some unique types of evidence and that will be discussed shortly, but for now, the primary decision by an investigator is to choose between plastic and paper containers. Paper containers include paper envelopes, glassine envelopes, and assorted types of cardboard boxes. Pretty much any evidence can be placed into a paper envelope or cardboard box, but one cannot visually see the evidence inside the container. Forensic supply companies do sell paper envelopes with a cellophane window on one side of the envelope. These envelopes are great if available, but they do not always grant the viewer visual access to all sides of the contents. If one must choose between plastic and paper, the primary rule to remember is that if the evidence is biological in nature, it must be packaged in paper. Placing blood or other serological evidence into plastic envelopes may cause the material to putrefy. Beyond being a stinky mess, the biological material will most likely be so degraded that it will not be able to be tested or identified by the laboratory. Plastic envelopes are good for anything that is not biological. Common types of evidence that are packaged in plastic envelopes include narcotics, ballistic evidence, currency, and anything that is a solid and is not biological in nature. If any of these items are stained with blood, then they should be packaged in paper.

There is one word of warning when it comes to packaging biological evidence and that is it must be dry prior to packaging it, even in paper. This is the reason why DNA swabbing samples are allowed to air dry prior to packaging. How to dry swabbing samples is detailed more completely in Chapter 7. Most of the time, if clothing evidence is wet, it is likely saturated in blood. Blood saturated clothing or other absorbent objects need to be hung up and allowed to air dry. Some agencies are blessed by having specially designed drying cabinets that are designed to dry items quickly. Other agencies may just have a secure area that is used to allow the items to dry naturally. Both manners of drying are effective, as long as the area is secure and does not introduce the possibility of contamination. When packaging items like bloodstained clothing, even after being dried, the items should not be folded up onto themselves and stuffed into a box. The clothing will need to be folded, but the clothing should be sandwiched between two sheets of clean butcher paper and folded so that the folded parts of the clothing are not touching each other or any other garment. This will help in protecting against contamination as well as protecting any bloodstain patterns that could be of assistance to the investigation.

As a final note on wet evidence, if a submerged vehicle is recovered, then everything in the vehicle will be wet and all absorbent evidence will need to be dried. The challenge with submerged vehicles is that if they are towed to a vehicle examination facility, then metal objects in the vehicle may start to rust. Specifically, firearms will rust very quickly once removed from the water. If an investigator is looking at a vehicle sometime after it has been pulled from the water and finds a weapon in the vehicle, it is very likely that the firearm has already started to oxidize. On the other hand, if an investigator is fortunate enough to be present when the vehicle is removed from the water, the evidence technician should quickly photograph the weapon in the position it was found, but soon after place the gun in a bucket of water. It is recommended, when possible, to fill the bucket with the same water from which the firearm was recovered. The weapon should be immediately taken to the firearms examiner. If one's firearms laboratory is not convenient, the weapon or other metal item should be stored in a bucket of water. The key is to not expose the weapon to air for an extended amount of time. Oxidation will begin on metal surfaces almost immediately. Therefore, placing the firearm or other metal item back in the water will slow the oxidation and rusting process on the item.

For the vast majority of evidence, the choice of packaging materials is going to be between plastic or some form of paper. However, there are some special containers for unique pieces of evidence. Knives and needles are two types of evidence that are better submitted into evidence in specialized containers. Knife and needle tubes are clear plastic cylinders with a Styrofoam® plug at one end (Figure 3.14). The sharp end of the knife or needle sticks into the Styrofoa

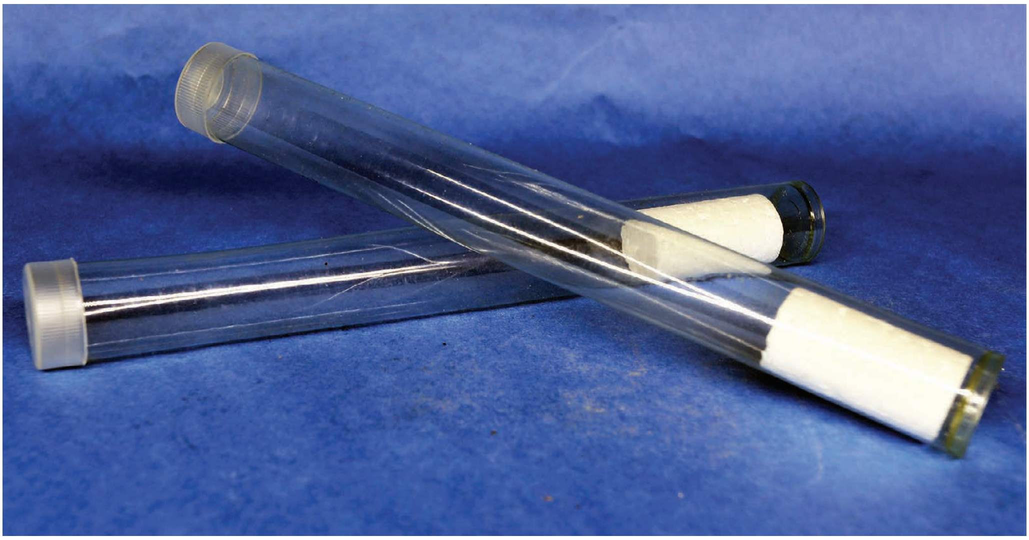


Figure 3.14 Knife and needle tubes are useful to protect evidence handlers from becoming injured by the sharp ends of the evidence. The plastic tubes have a Styrofoam plug at one end that secures the sharp ends of knives and needles.

and protects any handlers of the evidence from being injured. Other unique packaging containers would include glass and metal containers. Glass vials can be used to store entomological evidence, specifically maggots. Glass vials can also be used to store liquid substances, such as suspect narcotics or poisons. Arson investigators commonly use metal paint cans to package potential accelerants or other fire-related evidence that are found at the scenes of arson investigations. These packaging supplies are used in unique scenarios, but the same overall considerations as to the marking, securing, and submitting of these containers into evidence are largely the same as any other piece of evidence.

Investigators should pick the size container that allows the object to fit comfortably inside without having to be squished or squeezed into the container, as well as not being so loose as to be flying around inside the container. Loose evidence that is destined for a latent print laboratory could actually have fingerprints removed by the movement of the object across the loose packaging. If the piece of evidence is moving around inside the container, most often a cardboard box, the item can be secured with zip-ties or by placing wadded up pieces of butcher paper inside the box to act as a buffer. Packaging is very likely to come in layers. Similar items, such as fired cartridge cases or fired bullets, will be placed into small individual evidence bags, but then numerous pieces of ballistic evidence can be placed into a single overall container. This goes for all types of evidence, DNA swabbing samples, clothing, and any other similar category of evidence. Similar items, recovered from the same vehicle can be packaged together, especially if they are broken up into smaller packaging inside of the outer packaging. Clothing is one exception to that rule. One would never want to place suspect clothing with complainant clothing in the same outer container, even if separated by smaller interior packages. One never wants to risk the cross-contamination of evidence that belongs to the complainant and suspect or give a defense attorney any reason to object to the admissibility of evidence at trial.

When an investigator has layers of packaging, each layer must have all the case information marked or printed on each individual package. It is possible that something may become separated from its parent container and without all the case information printed on each smaller container, then the chain of custody may be lost and the evidence inadmissible in a court of law. The information should be handwritten in ink on each package. Some agencies may use printed labels that are adhesively attached to evidence containers. If one's agency uses such printed labels, it is recommended to also handwrite the case information somewhere on each container as well. There are two reasons why and the first is that some of these labels will fade over time, especially in warmer environments. The second reason occurs at court when testifying in front of a jury. The prosecutor needs to offer the items up to the court for admission into evidence and that is done by establishing the chain of custody through the investigator that recovered the item. With the handwritten case information and item identification, the investigator can tell the jury that they can positively identify the item because of the unique identifying information written in their own handwriting. It may seem to be a very small nuance in the testimony, but communicating decisiveness and clarity to the jury is important. It also shuts the door to any potential attack from the defense counsel. Individual agencies may have specific requirements as to what is on each package, but at the very least, the information that should be placed on each layer of packaging should include the following:

- Case or incident number
- Date of recovery

- Description of evidence, including any associated identifier (numeric or alphabetical)
- Name of submitting investigator and employee or badge number

Anytime the case information is placed on a plastic bag or plastic tube, the information should be covered with cellophane or packing tape. If the information is not covered over with tape, it can be easily wiped off.

Securing evidence packages is done primarily by taping the packaging closed. Unlike the impression seen on television crime dramas, the red-colored "evidence tape" or tamper-resistant tape is not what secures or seals each container. This tape is merely to show if the evidence package had been tampered with. All packaging needs to be sealed with packing tape and that tape should be placed across the entire open seam of the container and wrapped around the edges of boxes and envelopes. The evidence or tamper-resistant tape gets layered on top of the packing tape and seams. The investigator needs to finish off the packaging of evidence by using a permanent marker to sign or initial across the evidence tape. The initials or signature should include the investigator's unique badge, employee, or unit number, as well as the date the item was packaged. This information should touch three surfaces: the evidence tape, the packing tape, and the container itself. By properly documenting and securing all evidence, the evidence technician ensures that all chain of custody issues are protected and the item will be much easier to admit into court as evidence.

After the vehicle's identification and all the evidence have been recovered and documentation is complete, it is time to release the vehicle. Every agency will have their own standard operating procedures for dealing with the disposition of vehicles. These procedures are likely written to follow state laws and local government codes. Vehicles should be returned to the registered owners or an individual able to show proof of ownership. Some vehicles may go unclaimed because of the amount of damage or lack of insurance. In those cases, a letter sent via registered mail is often required before a jurisdiction can claim or dispose of a vehicle. Unclaimed vehicles and legally seized vehicles make excellent training vehicles. Fire departments can use them for rescue and fire training, and crime scene investigators can use them for different training scenarios, including shooting reconstruction and evidence processing. Whatever the manner a vehicle is disposed of, the documentation and record-keeping of the vehicle is not over until the vehicle is no longer in the custody of a law enforcement agency. The evidence technician can conclude their involvement in the case once they complete a thorough and detailed report documenting all their actions, including a detailed list of all recovered evidence. The evidence technician may also wish to complete a set of crime scene diagrams to accompany the written report. The final responsibility of the vehicle's examiner is to submit all recovered property into evidence or give care, custody, and control of the evidence directly to the different laboratories. Of course, the work of a vehicle examiner is never quite done. There is bound to be another vehicle to process waiting in the wings.

Conclusion

The processing of vehicles for evidence is much more than capturing a couple of photographs and digging a few fired bullets out of a car's door. The careful orchestration and coordination of vehicles through an examination facility does not just happen. It requires a well-organized facility that is in constant awareness of all the vehicles in their immediate control. Vehicles must be tracked from the moment they arrive at an examination facility until they are released back to their owners or otherwise disposed of. This is necessary to maintain a chain of custody for all evidence recovered from a vehicle. The other mandate necessary to ensure that recovered evidence is admissible in court is to have a legal right to search the vehicle. The U.S. Constitution and, specifically, the Fourth Amendment, protects citizens from unreasonable searches and seizures. As a result, investigators are tasked with the need to obtain a search warrant or a consent to search from the vehicle's owner. Once the legality of the search is obtained, then the processing of the vehicle can begin. In general, the evidence technician works from the exterior toward the interior of the vehicle. In addition, any processes on the vehicle should begin with the least intrusive or destructive, such as photography, to the more destructive processes, such as taking portions of the vehicle apart searching for evidence. After the vehicle has been processed, it can be released from the care, custody, and control of the examination facility. The investigator completes their responsibilities in the case by writing a detailed report and submitting all recovered property into evidence.

Additional Readings

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Review Questions: General Guidelines and Strategies for Processing Vehicles

1. Which case did the U.S. Supreme Court rule that the seriousness of an offense does not in itself create exigent circumstances?
    a. *Mapp v. Ohio*
    b. *Mincey v. Arizona*
    c. *Weeks v. the United States*
    d. *Schneckloth v. Bustamonte*

2. What was Rufus Mincey accused of doing that resulted in the 4-day search of his apartment?
    a. He possessed bomb-making paraphernalia
    b. He possessed child pornography
    c. He murdered a police officer
    d. He murdered his parents
3. When an investigator has doubt as to the legality of a vehicle's search, what should they do?
    a. Obtain a search warrant
    b. Ask for clarification from the vehicle's owner
    c. Let the case investigator make the decision
    d. Let a supervisor make the decision
4. What two factors are important for a consent to search to be valid?
    a. Admissibility and voluntary
    b. Voluntary and the person has authority to grant consent
    c. Admissibility and justifiable
    d. Admissibility and the person has authority to grant consent
5. Which of the following will cause a consent to search to be invalid?
    a. Coercion
    b. Force
    c. Promises
    d. All of the above
6. Which U.S. Supreme Court case rules that consent to search must be made voluntarily?
    a. *Mapp v. Ohio*
    b. *Mincey v. Arizona*
    c. *Weeks v. the United States*
    d. *Schneckloth v. Bustamonte*
7. Verbal consents to search are admissible in court.
    a. True
    b. False
8. Which of the following is NOT one of the exceptions to the warrant requirement of the Fourth Amendment?
    a. Abandoned property
    b. Probable cause
    c. Need to prevent loss or destruction of evidence
    d. Plain view
9. Which U.S. Supreme Court case stated that evidence recovered during illegal searches is not admissible in any court, federal or state?
    a. *Mapp v. Ohio*
    b. *Mincey v. Arizona*
    c. *Weeks v. the United States*
    d. *Schneckloth v. Bustamonte*
10. What was Dollree Mapp charged with after the search of her home?
    a. She possessed bomb-making paraphernalia
    b. She possessed child pornography
    c. She possessed obscene material
    d. She possessed an illegal firearm

11. What does the Fourth Amendment protect citizens from?
    a. Illegal searches and seizures
    b. Any searches and seizures
    c. Unreasonable searches and seizures
    d. Inadmissible searches and seizures
12. Other than the vehicle's dashboard, where might an investigator look for another vehicle identification number (VIN) plate or sticker?
    a. Front of the engine
    b. Firewall
    c. Driver's side "B" pillar
    d. All of the above
13. Which digit in the vehicle identification number represents the vehicle's model year?
    a. 8th
    b. 10th
    c. 11th
    d. 13th
14. How many digits are a part of the vehicle's production sequence number?
    a. 6
    b. 10
    c. 12
    d. 17
15. Which year did vehicle identification numbers became a standard 17 digits in length?
    a. 1975
    b. 1981
    c. 1992
    d. 2000
16. What would be the best container to package a bloodstained T-shirt into?
    a. Plastic garment bag
    b. Cardboard box
    c. Plastic evidence bag
    d. Metal paint canister
17. What container would be the best choice for packaging a fired bullet?
    a. Small paint can
    b. Glass evidence jar
    c. 2"×2" plastic evidence envelope
    d. 11"×17" plastic evidence envelope
18. What should be completed before a blood-saturated pair of blue jeans are tagged into evidence?
    a. Blue jeans should be cleaned prior to submission
    b. Blue jeans should be analyzed for bloodstain patterns
    c. Blue jeans should be placed in refrigerated storage
    d. Blue jeans should be allowed to air dry prior to submission
19. What is the best method for recovering a firearm from underwater?
    a. Allow the firearm to air dry
    b. Package the weapon in a sealed plastic bag
    c. Place the weapon in a container full of water
    d. Process the weapon for fingerprints and DNA immediately upon recovery

20. An investigator should put the case number, investigator's name, and a full description of the evidence on the exterior of all packaging. What else should be on each level of packaging?
    a. Date of the incident
    b. Date of evidence recovery and packaging
    c. Owner's name
    d. Complainant's name
21. Evidence or tamper-resistant tape is designed to secure all types of packaging containers.
    a. True
    b. False
22. What should be written across each piece of evidence tape placed on a container?
    a. Investigator's name or initials
    b. Investigator's employee or badge number
    c. Date evidence was packaged
    d. All of the above
23. What best describes what an arson investigator seeks to determine regarding fire scenes?
    a. How the fire burned
    b. The cause and manner of the fire
    c. The cause and origin of the fire
    d. Why the fire started
24. What best describes what a forensic anthropologist can help with?
    a. Identification of osseous matter
    b. Identify a body based on dental records
    c. Identify the cause and manner of death
    d. Determine the time of death
25. Which forensic pioneer coined the phrase, "Every Contact Leaves a Trace?"
    a. Sir Francis Galton
    b. Edmund Locard
    c. Earl Warren
    d. Barry Headricks

The Documentation of Motor Vehicles

4

The one guiding principle for everyone from rookie police officers to senior crime scene investigators is that if something is not written down, then it never happened. This philosophy applies to every aspect of the vehicle examiner's assignment, from the recording of scene notes to the final written case report. All documentation tasks are vital for investigators and evidence technicians to complete in order to have a successful investigation of a criminal case. A criminal case is only as strong as its weakest link and the last thing an investigator wants to face is a defense attorney tearing apart an investigator's work in the courtroom, especially in front of a jury. The investigator's goal and their duty are to find the truth. It is not about getting a conviction. However, to reach a potential courtroom, case investigators and evidence technicians must be able to write a coherent report, logically written, and based on facts. And all of this begins with taking quality notes.

Note-Taking

Recording notes about a vehicle sounds like a fairly straightforward endeavor. Simply, write down all the pertinent data, information, and call it a day. However, any lackluster effort one puts into their investigation and data collection will ultimately be revealed in the ability to successfully work a criminal case. There is no room for cutting corners in any criminal investigation. That point cannot be stressed enough. In today's world, with all its technological advances and lightning-fast advances in crime scene investigation tools, it may be difficult to realize the importance of putting pen to paper and writing information down. This is especially true with more and more agencies trying to "go paperless." Nothing in this book should override what a particular agency's standard operating procedures (SOP) are. If an agency allows for the photographic, digital, or voice recordings of notes then one may utilize these technological tools. Regardless of the manner of how notes are recorded, they still must be thorough and complete.

There have always been basic guidelines concerning any note-taking efforts by law enforcement officers and investigators. First and foremost, the investigator needs to maintain neat and legible notes. Notes are used to write a coherent final report, but these reports are not always written immediately after a vehicle or crime scene is processed. Furthermore, investigators may get called to process another scene or vehicle in the meantime. Therefore, an investigator should not rely on their memory for important details. It must be written down, and it must be legible so that it can be read at a later time, which in rare cases may be quite a bit later. Written notes need to be completed in ink pen, not pencil. Erasures are not acceptable and can cause difficulty in court. It is perfectly acceptable to make mistakes and corrections, but simply draw a line through the incorrect information and write the correct information next to it. There are a few commonsense hints that can make one's notes easier to read. Primarily, please do not try

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to cram as much information onto a single page of the paper. Everyone wants to be environmentally responsible and save on the use of paper, but cramming words together and writing as small as possible will literally cause headaches when it comes time to read the notes and write the report. Use additional paper as needed, even if it is to just complete a single observation. Another hint to help the investigator read their own work is to organize their processing steps and separate them in the notes. The investigator can break up their notes by areas of the vehicle processed or by the processes performed, but try not to force everything together to save space. Different colored pens are also beneficial. Using different colored ink pens can help one's eyes separate important information on a page, especially similarly appearing information, such as overall versus evidentiary measurements or between fingerprint evidence and DNA evidence collections.

Beyond being able to read one's own notes in order to complete a quality written report, crime scene notes are admissible in court and it is not uncommon to have an investigator's notes subpoenaed by defense attorneys, especially in high-profile cases. Defense attorneys will be looking for contradictions in one's written notes and one's final report. In addition, if something is not legible, then the defense attorney might point it out in court and ask the investigator to clarify the scribbles. If the investigator cannot interpret what was written, the trial's outcome could be affected. On that note, one should not place anything in their notes that does not pertain to the criminal case. Everything on an investigator's written notes is exculpatory in court and if an investigator was to write a personal or private note to themselves on a convenient corner of the case notes, that information could be disclosed and questioned in court. Furthermore, one should not take notes or record notes on their personal cell phone. Every photograph recorded is technically considered evidence and must be submitted as such. There have been cases where a cell phone was used by an officer completing their investigation and that phone ended up being turned over to the defense attorney at trial. Although this may be a very rare event, it only takes one time to ruin an investigator's day in court. Photographic notes may be taken with one's camera, but do not use a personal cell phone's camera to take notes.

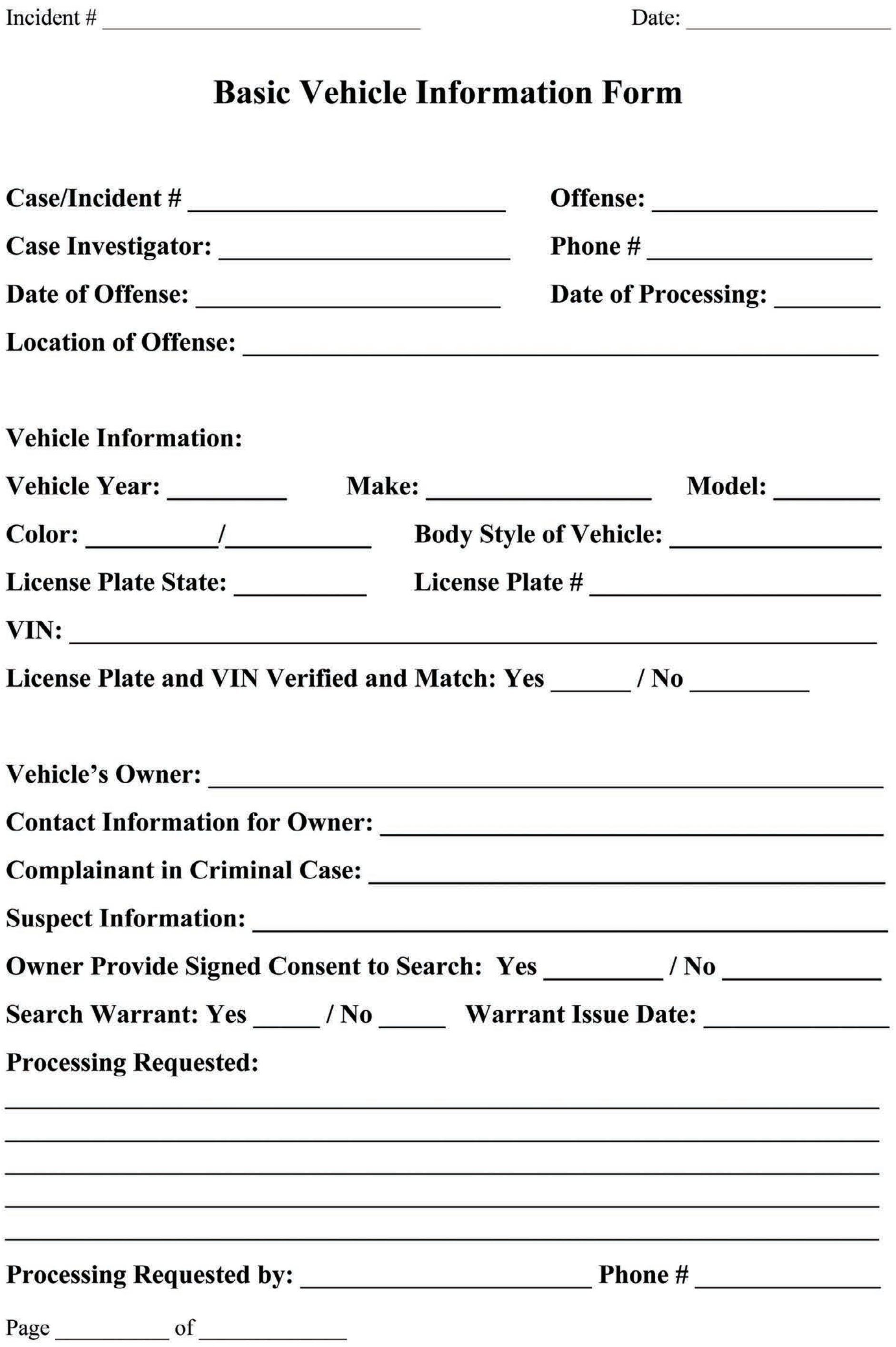
Many agencies are seeking accreditation for both the law enforcement agencies and their forensic laboratories. The accreditation standards may be coming from the Commission on Accreditation for Law Enforcement Agencies (CALEA) that accredits public safety agencies or they may be coming from the International Organization for Standardization (ISO) that accredits forensic laboratories. The ISO standards for 17020 and 17025 are the most common accreditation standards for forensic laboratories, but that may filter down in some agencies to those working in crime scene or forensic evidence units. These standards are numerous and detailed. Included in these standards are clearly defined procedures for how notes are recorded and preserved. For example, standards may include that every page of notes must be paginated, they cannot have erasures, mistakes must be corrected in a specific way, one can only write on one side of the paper, etc. In the end, the old days of pulling out a pocket notebook and scribbling down a few key points about an investigation are no longer valid. One should also work with the old saying, "garbage in—garbage out" frame of mind. Quality note-taking results in quality report writing.

For those who routinely work in a vehicle examination facility, using a preformatted vehicle processing template would make one's written documentation of a vehicle much more efficient. A vehicle processing template simply makes sure that the small details of a vehicle are not forgotten during the processing of a vehicle. Each vehicle is going to be different in what processing requests have been made by investigators and blank paper will be routinely needed as well. Templates can be tailored to each individual investigator's personal preferences, but the basic information regarding each vehicle is likely to be similar. Accrediting entities for law enforcement agencies and laboratories also will demand standardized forms and other documents. Therefore, any commonly used note-taking templates, consent to search forms, processing request forms, etc., all need to be standardized and approved for accreditation purposes.

Developing a workable template for processing vehicles is most likely an individual task, based on one's personal preferences and desires. Different evidence technicians will look at vehicles differently and want different aspects of the investigation more prominent on their own particular form and/or just in a different order. However, the basic information regarding the case information and the identification of the vehicle being processed is fairly general across all agencies and laboratories. Returning to the idea that an investigator should not cram everything onto one page of notes, vehicle template forms can be made in a variety of formats for different types of investigations. The vehicle templates can be generic for the basic case information while being extremely specific like those designed to document the tracking of fired bullets through a vehicle. Investigators should consider having a selection of pre-printed forms available that they can choose from when heading out to process a vehicle.

The processing of a vehicle always begins with a criminal act, who exactly is investigating that criminal act, and what vehicle needs to be examined for evidence. These basic facts are routine, but in order to avoid the forgetting of some small detail, a vehicle template or processing form can be useful to investigators (Figure 4.1). The first processing form example, as seen in Figure 4.1, begins at the top with the basic case information, including the tracking or incident number and crime being investigated. Since the processing of vehicles at an examination facility typically involves more severe criminal acts, there is likely a criminal investigator or detective assigned to the case. A phone number, e-mail address, or some way to contact the detective is going to be of utmost importance, because except in small agencies, the primary-responding patrol officer, detective, and evidence technician are likely three different people, and communication between the three is important to understand what exactly is needed on the vehicle. The date of the offense and the location of the offense may seem unnecessary, but there will be times when case numbers are wrong or have been changed and most agencies will have a way in which to search cases by date, location, and the complainant. This information may not be on every agency's form, but it acts as a check to ensure all information is accurate.

The middle section on the vehicle processing request form is the vehicle's information. Basic vehicle identification is gathered off the car and placed in this section. The license plate and the vehicle identification number (VIN) should be recorded as found on the vehicle. If one or the other is stolen, altered, or swapped, then that too can be noted on the processing form. Each vehicle should be run through the state's vehicle registration database and the VIN and license plate matched and verified. In addition, when the license plate is run to obtain the VIN, it should also let investigators know if the vehicle was reported stolen. Any stolen returns should be cleared prior to returning the vehicle to its owner. The vehicle's year, make, and model are self-explanatory. One will notice that there are two boxes for color. The first box is for the vehicle's top color or the color of the roof and the second box is the main body's color. If the colors are the same, the second box can be left blank. The body style is the basic design of the vehicle: two-door, four-door, pick-up truck, passenger van, cargo van, etc.



Incident # ____________________ Date: ______________

Basic Vehicle Information Form

Case/Incident # ____________________ Offense: ______________

Case Investigator: __________________ Phone # ______________

Date of Offense: ___________________ Date of Processing: _______

Location of Offense: ____

Vehicle Information:

Vehicle Year: ________ Make: ______________ Model: _______

Color: ________/_________ Body Style of Vehicle: ______________

License Plate State: _________ License Plate # __________________

VIN: ____

License Plate and VIN Verified and Match: Yes _____ / No ________

Vehicle's Owner: ____

Contact Information for Owner: _______________________________

Complainant in Criminal Case: ________________________________

Suspect Information: ____

Owner Provide Signed Consent to Search: Yes ________ / No __________

Search Warrant: Yes ____ / No ____ Warrant Issue Date: ____________

Processing Requested:

____

____

____

____

____

Processing Requested by: ____________________ Phone # ____________

Page ________ of __________

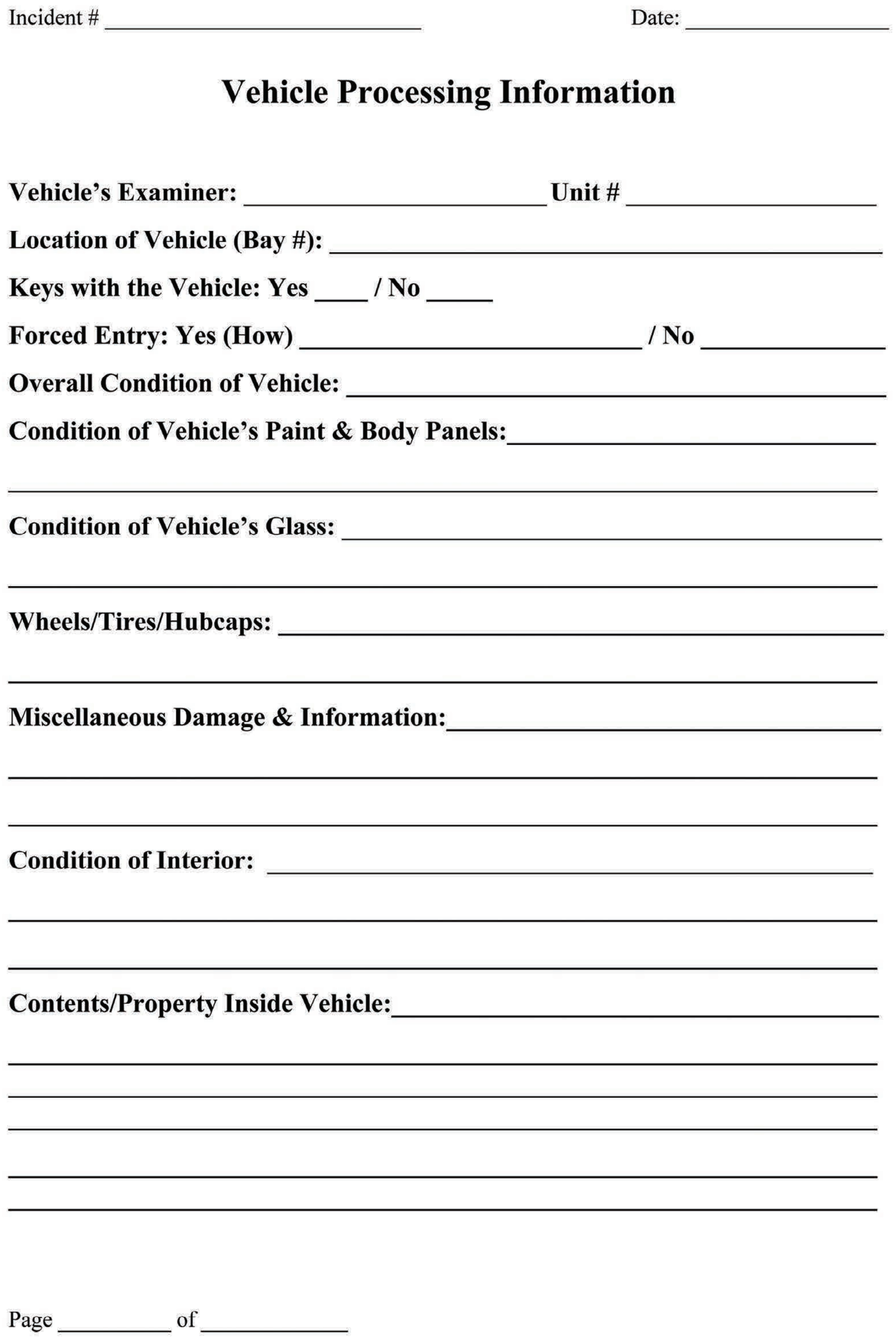
Figure 4.1 Investigators can work more efficiently and not unintentionally forget small pieces of information regarding a vehicle's identification and processing by utilizing some form of an evidence and vehicle templates. This figure shows an example of a template that documents the basic information of a vehicle and the evidence processing requested.

The last section of the form depicted in Figure 4.1 involves the owner of the vehicle and how legal access to the vehicle was obtained. Just because the vehicle is involved in a crime does not mean investigators can necessarily search it without consent or a warrant. In addition, the complainant or victim in the case may not be the owner of the vehicle. The owner of the vehicle must give permission or consent to search the vehicle and if they refuse, then a search warrant must be obtained. If the case's complainant is the owner, then that can be noted. If a search warrant is required, then the date the warrant was signed by a judge needs to be noted. Search warrants are not like arrest warrants that last as long as the wanted person is at large. Search warrants have an expiration time, which is typically 3 days.

The final section of the form depicted in Figure 4.1 is where the evidence technician speaks with the criminal investigator and discusses the case. It is here that the evidence technician will document exactly what the criminal investigator wants processed. This is a collaborative discussion. The evidence technician can help the case investigator understand what is and is not possible regarding the processing of evidence and what kind of damage may be done during the search of a vehicle, especially when it comes to ballistic evidence. The examiner should make note of any limitations on a vehicle's search, especially when it involves the potential disassembly and/or the damaging of a vehicle to retrieve evidence. The last line of the form documents who the evidence technician spoke with about the vehicle's processing. Hopefully, this is the same person assigned to investigate the case. However, even detectives take vacations, are stuck in court, or get sick. Consequently, this line is mostly for the vehicle examiner's protection. If the examiner is told to recover all the ballistic evidence regardless of the damage and that information turns out to be incorrect, then the evidence technician is somewhat covered by recording the authorization. As with all notes, being thorough and complete can save an investigator from a great deal of unwanted stress.

The second template shown in Figure 4.2 concerns the condition of the vehicle prior to the vehicle's examination. This is a protection for the vehicle's owner, as well as for the evidence technician who is examining the vehicle. Recording the contents of the vehicle and the condition of the vehicle is a protection against untruthful allegations of theft or unsubstantiated damage to the vehicle. Photographs should accompany and support the written documentation of the condition and contents of the automobile. As with any preformatted forms an investigator chooses to use, this form begins with a case number reference at the top of the form. All forms should have some sort of reference number or case number so that if the form becomes accidentally separated from the case file, then it can easily be returned to where it belongs. The next line in the top portion of the form in Figure 4.2 is the location of where the vehicle is being processed. If the vehicle is being processed in the field, then the address would go on this line. If the vehicle is being processed in the vehicle examination building, the address of the facility or the examination bay number can go on this line. The next question on the form is whether or not the vehicle came to the vehicle examination building with keys. This is important if forced entry is required on the vehicle. If forced entry is required to gain access to the automobile, this information needs to be documented in the notes and the written report. There are ways to gain access to a vehicle without breaking a window or damaging the vehicle in some expensive fashion. An investigator also might want to record any attempts to find a set of keys so that additional damage to the vehicle does not have to occur.

Recording the condition or damage to the vehicle is the main point of Figure 4.2. Of course, the vehicle is going to be photographed in a 360° manner prior to processing, but



Incident # ______________________ Date: ______________

Vehicle Processing Information

Vehicle's Examiner: _____________________ **Unit #** __________________

Location of Vehicle (Bay #): ____

Keys with the Vehicle: Yes ____ **/ No** _____

Forced Entry: Yes (How) _________________________ **/ No** _____________

Overall Condition of Vehicle: _______________________________________

Condition of Vehicle's Paint & Body Panels:___________________________

____

Condition of Vehicle's Glass: ____

____

Wheels/Tires/Hubcaps: ____

____

Miscellaneous Damage & Information:_________________________________

____

____

Condition of Interior: ____

____

____

Contents/Property Inside Vehicle:____________________________________

____

____

____

____

____

Page _________ of ___________

Figure 4.2 This vehicle processing form documents the overall condition of the vehicle being examined and the contents of the vehicle.

important aspects of the vehicle's condition need to be written down as well. The overall condition of the vehicle is more of a one- or two-word descriptor because the more detailed information will come next. Descriptors might include new, heavily wrecked, burned, lightly damaged, or simply good. The specific notations that follow can clarify the simple descriptor written down on the form. Condition of the vehicle's paint would include things like scratches and dents, as well as oxidation and peeling paint. The vehicle examiner cannot help what wrecker drivers do or how they may inadvertently damage a vehicle, but recording the condition of the paint and body may help protect an investigator from unwarranted damage claims. The condition of the vehicle's window glass refers to chips, cracks, and breaks. This is also the location to place information on the vehicle's window tint, if so equipped. The amount of window tint might be an issue in a case when what a witness could or could not see inside a car. There are tint density meters available to investigators, but if an evidence technician does not have such a device, then they should describe the tint as best they can by describing the tint's density using descriptive vocabulary. An investigator might also make note of whether the windows were in the down or up position. This too may become an important part of an investigation. Designer wheels and hubcaps can be very expensive and like documenting the valuables inside the automobile, it is also important to record the condition and type of wheels and tires. For example, notations about any physical damage to the wheels and tires are recorded here, and also make note of the style of rims and/or hubcaps. The form's final miscellaneous damaged box for the vehicle's exterior is available to simply document anything of note that did not fit in another category, such as a unique after-market feature or missing trim pieces. If the damage done to the vehicle is germane to the criminal investigation, such as bullet strikes to the vehicle, broad statements such as the vehicle was impacted by numerous fired bullets is sufficient at this point because bullet strikes and other relevant damage will be documented in much greater detail later in the written notes.

The vehicle's interior is another component of the vehicle that should be documented prior to the vehicle's processing begins in earnest. The types of seating and the material which makes up the seating should be noted. Any damage to the vehicle's interior is of primary importance for this portion of the processing form shown in Figure 4.2. Reporting damage does not have to be so specific to document every individual stain, but should note the overall condition and the more significant rips, cracks, tears, and broken or missing interior parts of the vehicle.

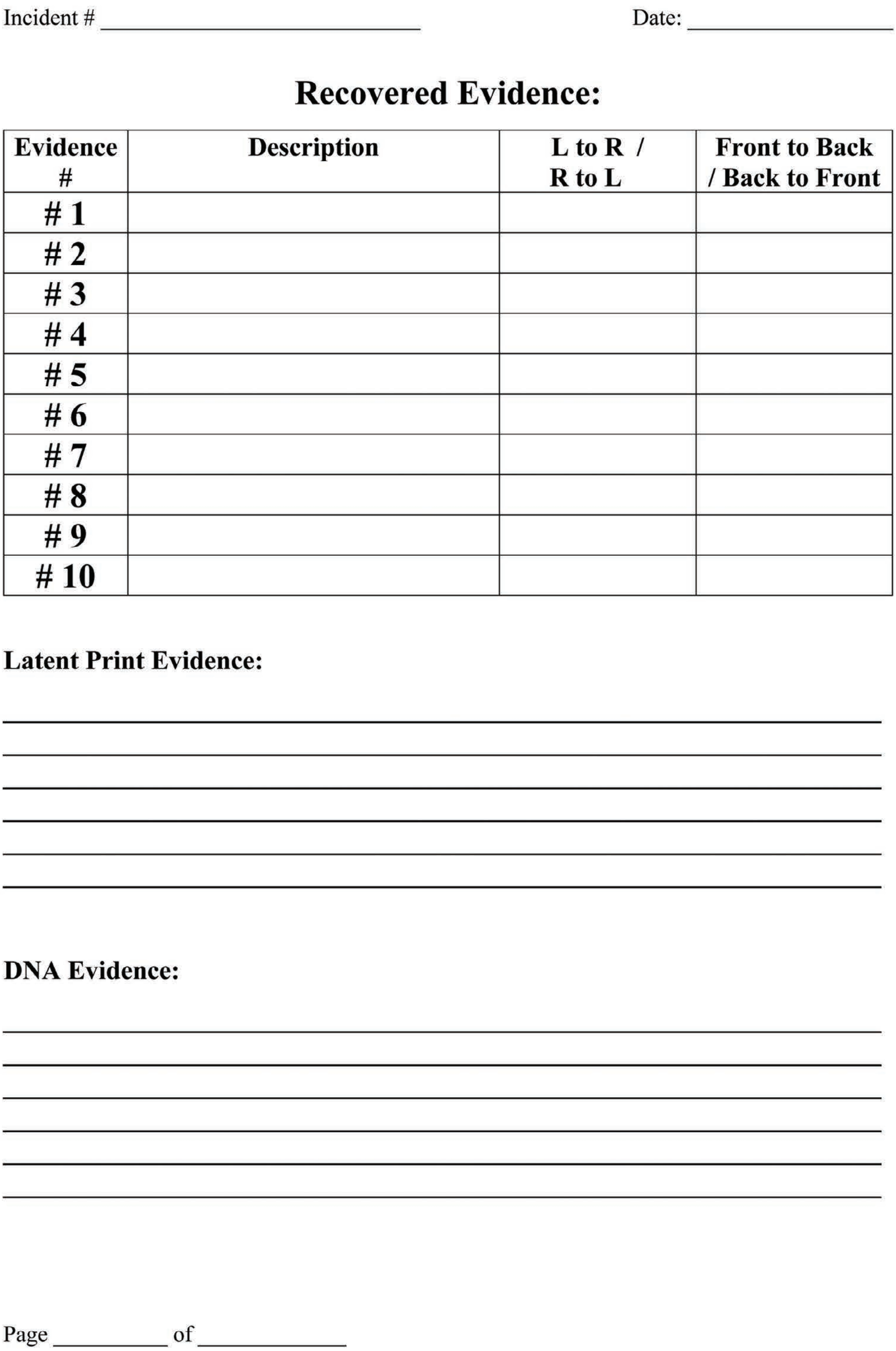
The vehicle's contents section is the final portion of this vehicle processing form. The contents of the vehicle should include items that are both affixed to the vehicle and that are loose. Items that are affixed to the vehicle might include audio equipment, such as the dashboard radio and speakers, as well as any performance add-on features observed. Recording the presence of or missing spare tire and jack would also fall into this category. The loose items inside the automobiles can be a real challenge to investigators because vehicles will arrive at the facility that the owners were living in and the automobile is filled from front to back with personal items. The amount of detail one wishes to put into documentation of the property may depend on a department's individual policies and procedures. The important property to document is the items of value. Expensive items such as computers, cameras, etc., should always be documented, and it is probably a good idea to record the serial number of the more expensive items. A small point-and-shoot camera may not need a serial number recorded, but it would be a good idea to record the serial number of a full-frame professional-type camera. Some items can be placed together, such as personal hygiene items, books, and school supplies. What is recorded in this section is up to the individual evidence technician and conducted in line with the agency's SOPs. Remember, the idea is to protect the investigator as much as it is to protect the vehicle's owner. It only takes one owner to claim that there was a brand-new laptop hidden under the driver's seat and because the investigator did not document the contents, an agency may not stand behind the investigator, leaving them with the replacement bill. However, if one documents the presence of the car radio, spare tire, assorted school supplies, a broken skateboard, etc., then the officer has shown due diligence to document all valuables inside the vehicle and did not "miss" a hidden laptop.

Organizing one's findings will help the offense report writing go much smoother and that is one purpose of having an assortment of processing forms. Not every form must be filled out, but using the forms that do apply to a vehicle's processing can assist with planning and maintaining the examination's methodology. Maintaining this methodology is assisted when an investigator keeps all labeling consistent between the recorded photographs, written notes, and the final offense report. Figure 4.3(a) has spaces for identifying recovered evidence, as well as a pair of boxes for recording the left to right or right to left measurements and the front to back or back to front measurements. Not every car will have a scale drawing completed, but when one is warranted, there is a place to record the necessary measurements on this form. Besides fingerprint and DNA evidence, this form only has a box for the listing of ten items of evidence. There may be cases where the number of evidentiary items recovered from a vehicle is greater than ten, and in those times, an evidence technician can use the supplemental evidence form depicted in Figure 4.3(b) or simply a blank piece of paper. Fingerprint processing and DNA evidence collection efforts can be documented in the space provided at the bottom of Figure 4.3(a).

Bullet strikes and bloodstains that are found on vehicles can be much more numerous than ten, and as a result, these items can be listed on their own form, similar to the one depicted in Figure 4.4. The bloodstains that are placed on this form are those that have impacted a vertical surface, not necessarily a simple blood pool. Bloodstains like saturation stains and blood pools can be placed on the standard evidence form, Figure 4.3(a). However, this not a hard and fast rule. If an investigator wishes to make all bloodstains identified by letters, that is an excellent way in which to keep one's thoughts and examinations organized. One will notice that the identification of bullet strikes and bloodstains are identified by letters and not numbers. Evidence found on horizontal surfaces are generally marked with numbers, while evidence found on vertical surfaces are marked with letters. There are two reasons for this type of organization of evidence. One is that it helps make a quick mental separation of different pieces of evidence, which can be beneficial in court when testifying about a vehicle with numerous pieces of recovered evidence. The second reason is explained in detail in Chapter 9. Basically, when tracking fired bullets through an automobile, using a combination of letters and numbers helps make a logical sequence of multiple surfaces impacted by perforating projectiles.

Ballistic evidence is not limited to bullet strikes. It also includes the recovery of firearms. Furthermore, the documentation of firearms is not just about finding the weapon but recording all the different aspects and nuances of the weapon. Some of those nuances are easily forgotten while in the middle of a large or detailed investigation. The firearms recovery form depicted in Figure 4.5 may help investigators remember to properly document and "chart" a weapon. Charting a weapon involves recording how the weapon was loaded and chambered. The top of the form begins with the basics, the type or style of

(a)



Incident # ____________________ Date: ____________

Recovered Evidence:

Evidence #	Description	L to R / R to L	Front to Back / Back to Front
# 1			
# 2			
# 3			
# 4			
# 5			
# 6			
# 7			
# 8			
# 9			
# 10			

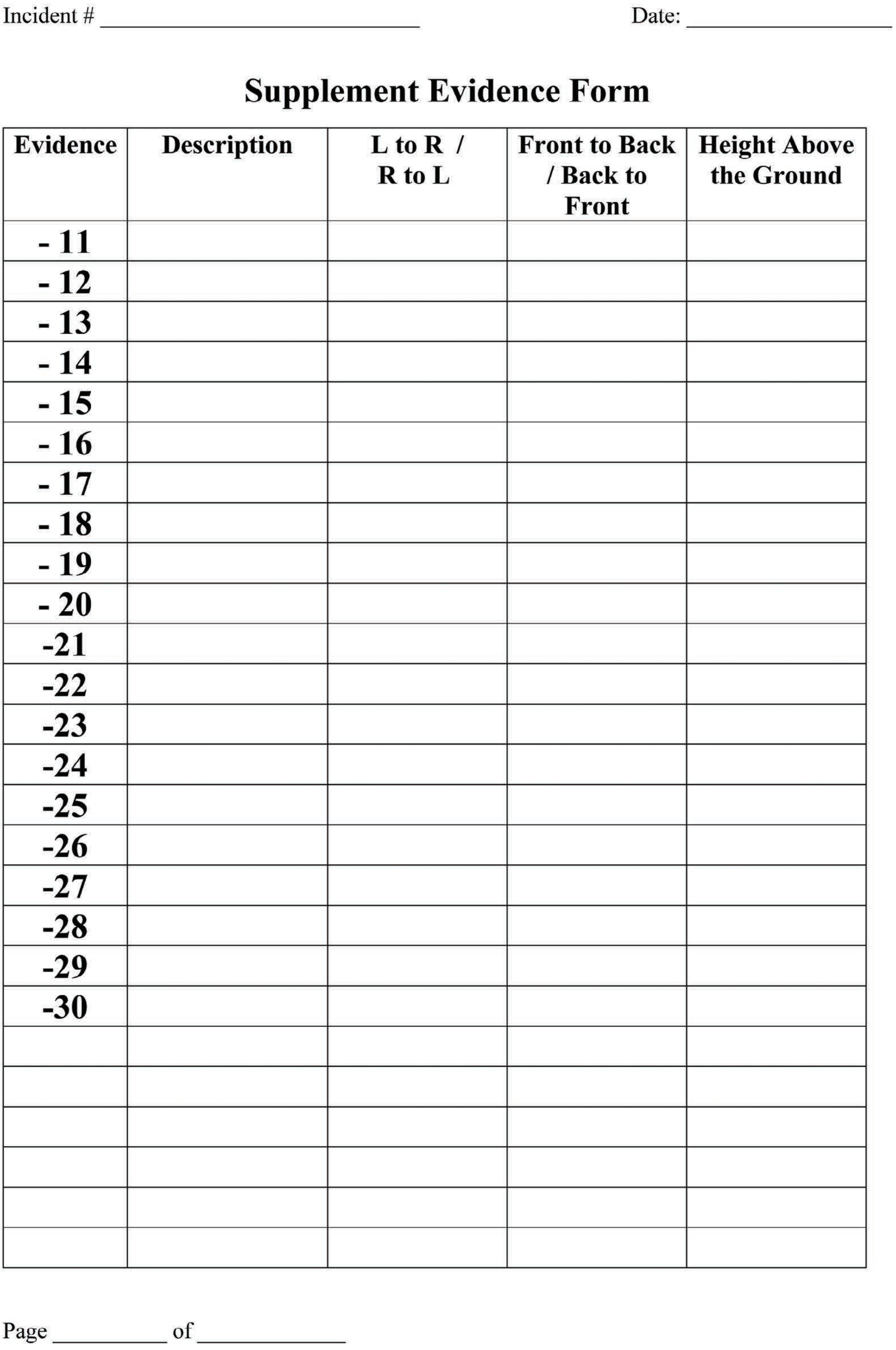
Latent Print Evidence:

DNA Evidence:

Page ________ of __________

Figure 4.3 (a) This processing form illustrates what a basic evidence recovery form might look like. It includes spaces for evidentiary measurements as well as an area for recording where fingerprint and DNA evidence were found.

(b)



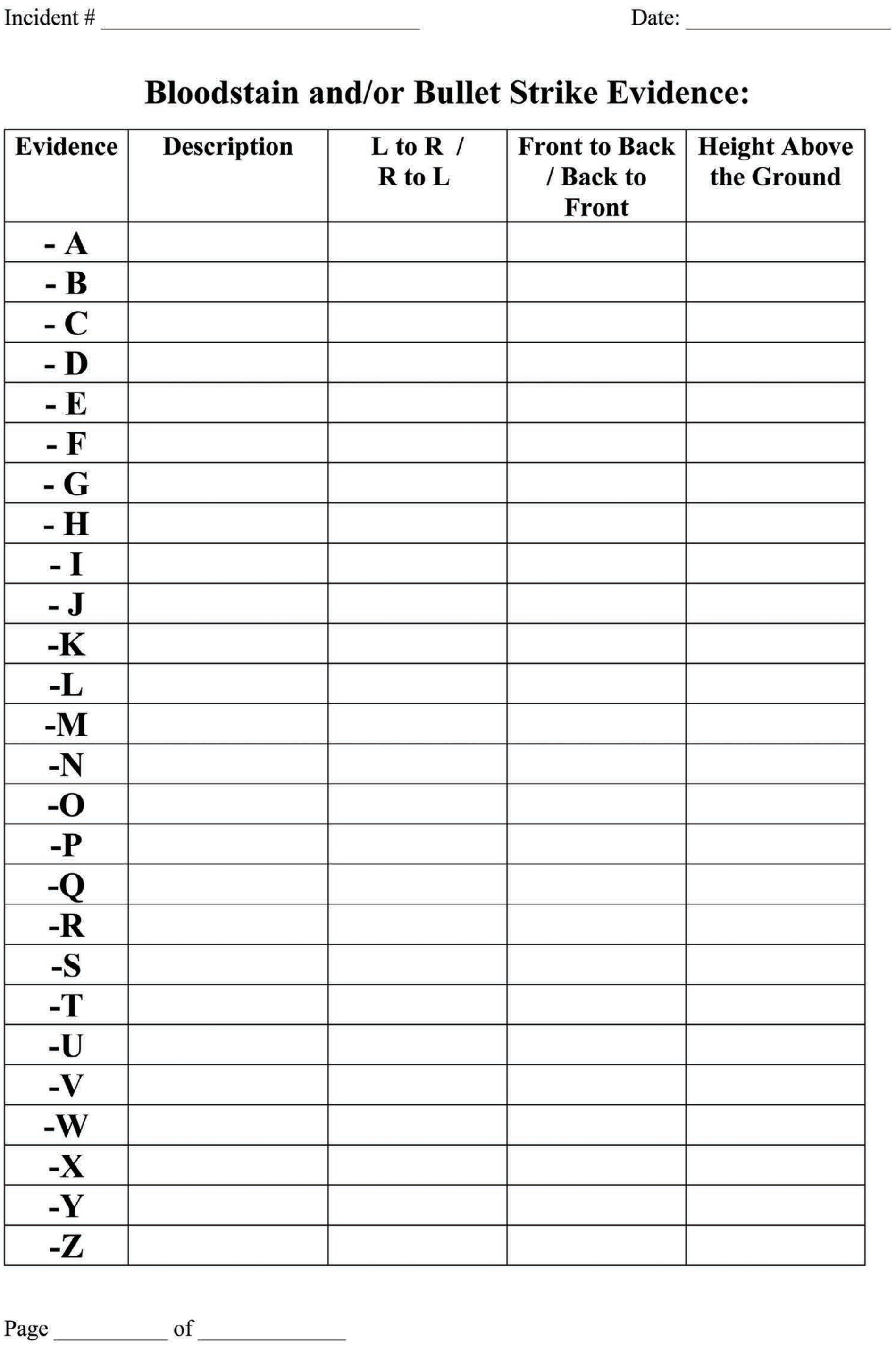
Incident # ______________________________ Date: ___________________

Supplement Evidence Form

Evidence	Description	L to R / R to L	Front to Back / Back to Front	Height Above the Ground
- 11				
- 12				
- 13				
- 14				
- 15				
- 16				
- 17				
- 18				
- 19				
- 20				
-21				
-22				
-23				
-24				
-25				
-26				
-27				
-28				
-29				
-30				

Page __________ of _____________

Figure 4.3 (Continued) (b) A supplementary evidence form may be needed occasionally when a greater number of evidence items are recovered.



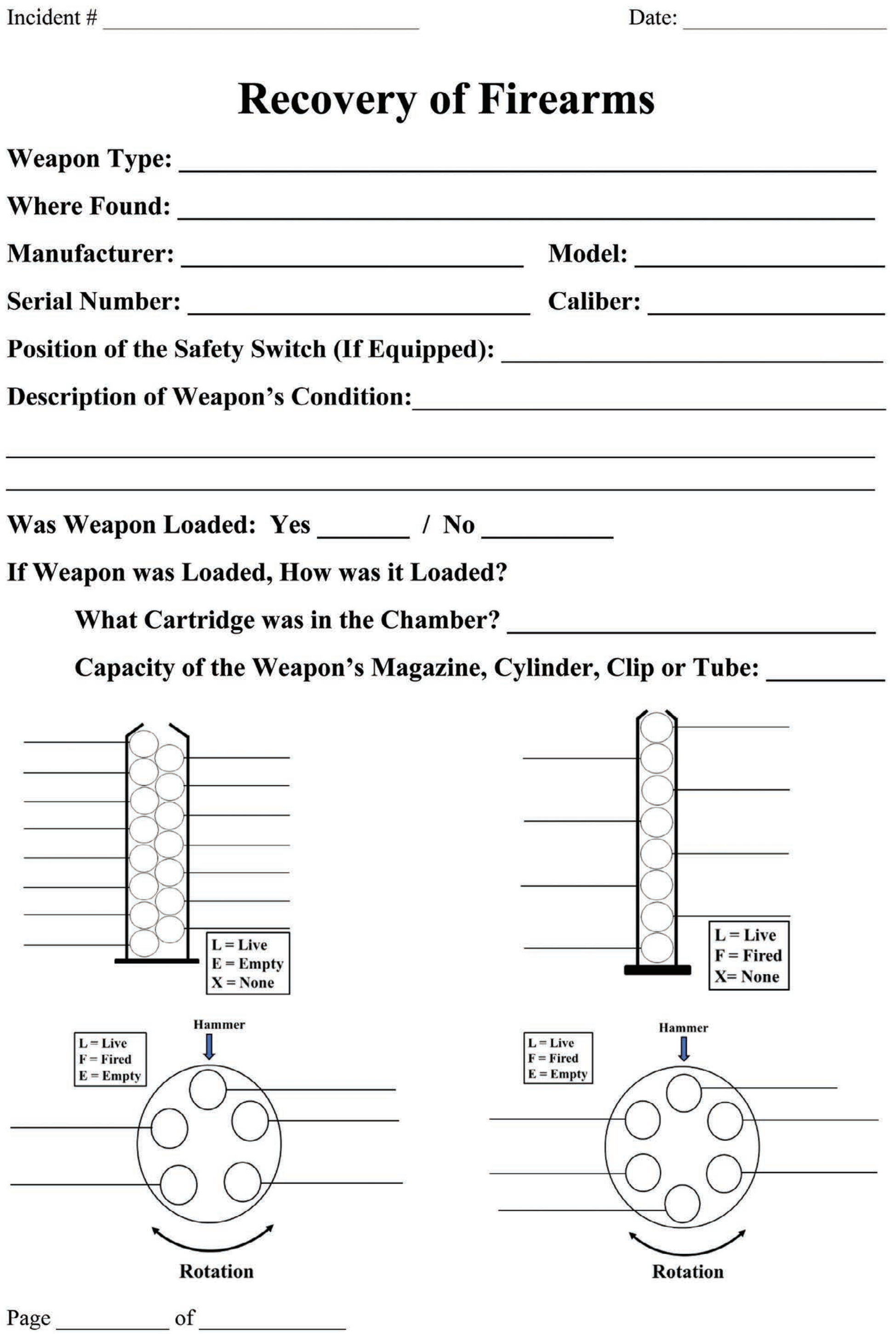
Incident # ______________________________ Date: ___________________

Bloodstain and/or Bullet Strike Evidence:

Evidence	Description	L to R / R to L	Front to Back / Back to Front	Height Above the Ground
- A				
- B				
- C				
- D				
- E				
- F				
- G				
- H				
- I				
- J				
-K				
-L				
-M				
-N				
-O				
-P				
-Q				
-R				
-S				
-T				
-U				
-V				
-W				
-X				
-Y				
-Z				

Page __________ of _____________

Figure 4.4 Bloodstains and bullet impacts can be more numerous than other physical pieces of evidence and as such, these items have their own document to record their identification and recovery. The form can be used for any evidence found on vertical surfaces. Note that there are three measurement recording boxes from the left to right (or right to left), front to back (or back to front), and the measured height of the evidence found.



Incident # ______________ Date: ______________

Recovery of Firearms

Weapon Type: ______________

Where Found: ______________

Manufacturer: ______________ **Model:** ______________

Serial Number: ______________ **Caliber:** ______________

Position of the Safety Switch (If Equipped): ______________

Description of Weapon's Condition: ______________

____

____

Was Weapon Loaded: Yes ______ / No ______

If Weapon was Loaded, How was it Loaded?

What Cartridge was in the Chamber? ______________

Capacity of the Weapon's Magazine, Cylinder, Clip or Tube: ______

L = Live
E = Empty
X = None
L = Live
F = Fired
X= None
L = Live
F = Fired
E = Empty
Hammer
Rotation
L = Live
F = Fired
E = Empty
Hammer
Rotation

Page ______ of ______

Figure 4.5 The full documentation of firearms found inside a vehicle is vitally important. Everything from the serial number to how the weapon was loaded is important information to record. Having a form specifically for firearms recovery helps ensure that nothing is missed in its documentation.

the gun (revolver, pump-action shotgun, etc.), and where the weapon was recovered from inside the vehicle. The specific identifiers of the gun are filled into the appropriate boxes. Remember to always double-check the serial number and make sure it was recorded correctly. Before a weapon is cleared or unloaded, the position of the safety, if so equipped, must be recorded, so that it can be documented in the final report.

Investigators should always document the condition of the weapon as a whole, including the barrel's interior surfaces. When examining a firearm, the investigator must make sure the weapon is cleared and double-checked that no ammunition is remaining in the weapon. Things like blood, dust, lubricant, and burn gunpowder that are present on the gun or inside the barrel all tell a story. Examining the weapon's barrel might indicate whether it had been fired or not. A clean-oiled weapon or a barrel filled with dust and lint would indicate that the weapon had not been recently fired [Figure 4.6(a)]. A weapon with gunpowder particles in the barrel would indicate it had recently been fired and a barrel with bloodstains in its interior would indicate that not only had it been fired but also it had been fired in close contact with the victim [Figure 4.6(b)]. Although the functionality of the weapon will be determined by the firearm's examiner, if the weapon had missing pieces, was damaged, or had extensive rust, then that is something of significance that should be documented in the crime scene investigator's report.

(a)

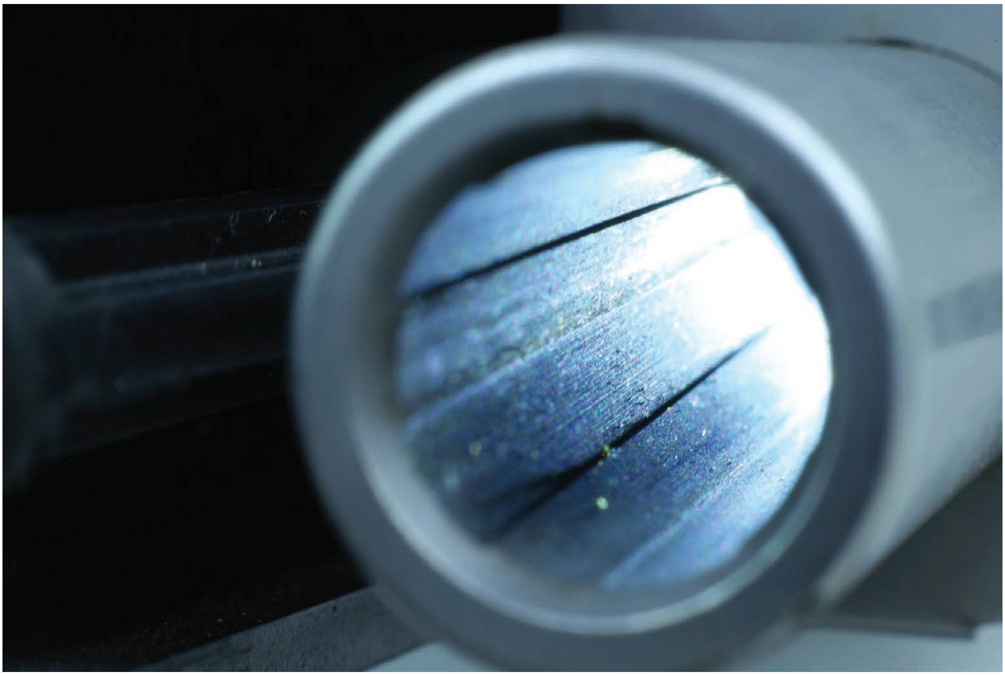


Figure 4.6 When a firearm is recovered, it should be examined and the overall condition of the weapon needs to be notated. Whether or not a weapon was fired may be of great value to an investigation. The weapon in (a) contained dust and lint inside the barrel, indicating that the weapon had not been fired recently.

(b)

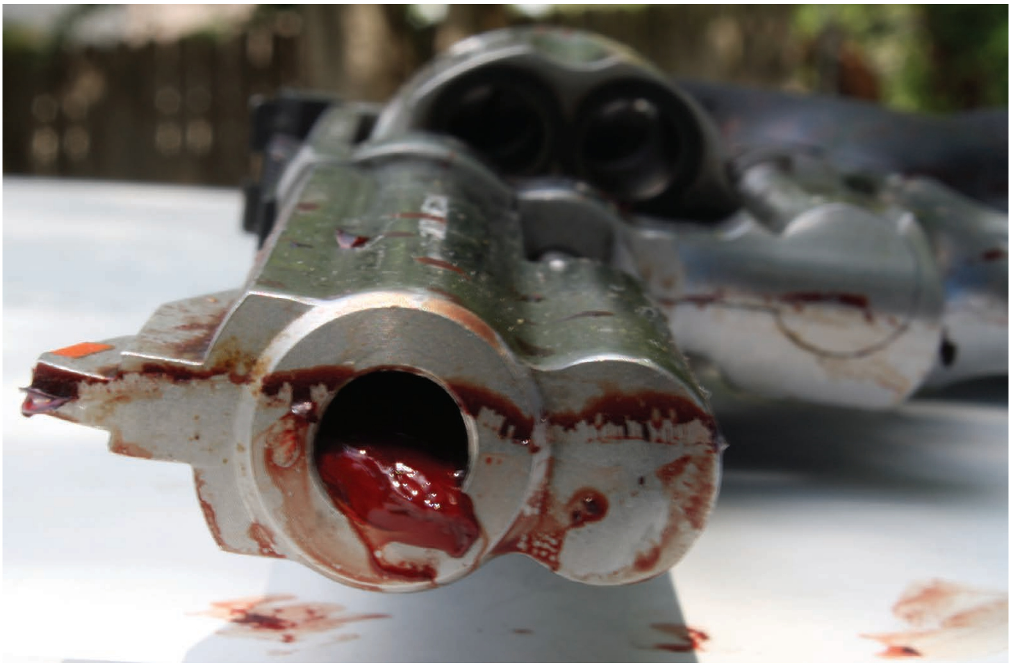


Figure 4.6 (Continued) The weapon in (b) contained blood inside the barrel, indicating that not only was the weapon recently fired but it was fired in close proximity with the victim.

The last portion of the firearms recovery form (Figure 4.5) involves how the weapon was loaded. As a word of warning, investigators should not jump in and start pulling out cartridges before a decision has been made on how or if the weapon and ammunition will need any processing for latent fingerprints and/or DNA evidence. The recovery of such evidence is covered in several locations throughout this book, including Chapter 9. When the weapon is opened and clear, the investigator should record the capacity of the magazine, cylinder, clip, or ammunition tube. Do not forget to add one to the total capacity number for all weapons except for revolver pistols and revolving rifles, because of the potential of having a round that has already been chambered. At the bottom of the form are some graphic representations of single stack and double stack magazines, as well as a five- and six-shot revolver's cylinder. Of course, there are more numerous capacity magazines and cylinders, but the ones depicted are the most commonly found. On the rare occasion that something unique is found, then the evidence technician will just have to create their own drawing of the weapon. If the magazine possesses less than the number of cartridges shown on the form, they can simply put an "X" in the cartridge circles or draw a line through the extra cartridge spaces. Ammunition clips are going to have a lower capacity, but they can still be documented using the pictures found on the firearm's recovery form by simply crossing out the extra cartridge spaces. With revolvers, investigators will also wish to notate whether the cylinder has a Live (L) or Fired (F) cartridge in a particular position or whether the chamber was Empty (E). The evidence technician should also record the direction in which the cylinder rotates by either circling the correct directional arrow or crossing out the incorrect arrow printed on the form. A magazine should not have a fired cartridge case found inside a magazine, but the live positions and the empty positions should be noted. The live cartridges plus the empty positions plus the one cartridge that might be in the chamber add up to the weapon's capacity. The weapon's total capacity is the same for ammunition clips and long guns equipped with magazine tubes. In the end, the documentation of firearms evidence can be of great value to an investigation and it should be complete and thorough. Using a "cheat sheet" or firearm's recovery form can be of great assistance toward that end.

The drawings of a pistol's magazine or cylinder is helpful because it is sometimes easier to draw a picture of something rather than write out all the detail. The same applies to the documentation of the vehicle's condition and or where evidence was recovered. Instead of writing out detailed descriptions, specifically where exactly some aspect or feature of the investigation was found, it may be easier to draw a simple outline of a vehicle and add a simple description or identifier to it. To that end, having a selection of pre-drawn vehicle outlines available may help with the documentation's clarity and efficiency (Figure 4.7). In Chapter 9, the use of templates showing the top-side or "birds-eye" views of vehicles are shown, and these can be used along with the set of drawings depicted in Figure 4.7(a) through (e). Crime scene drawing programs such as CrimeZone generally have a library of vehicle templates that an investigator could utilize. The different types of vehicles available can be printed from the computer program and used as a note-taking template.

All these templates are just examples that may be used by investigators or copied in some manner and adopted into their own work. Investigators can modify any of these

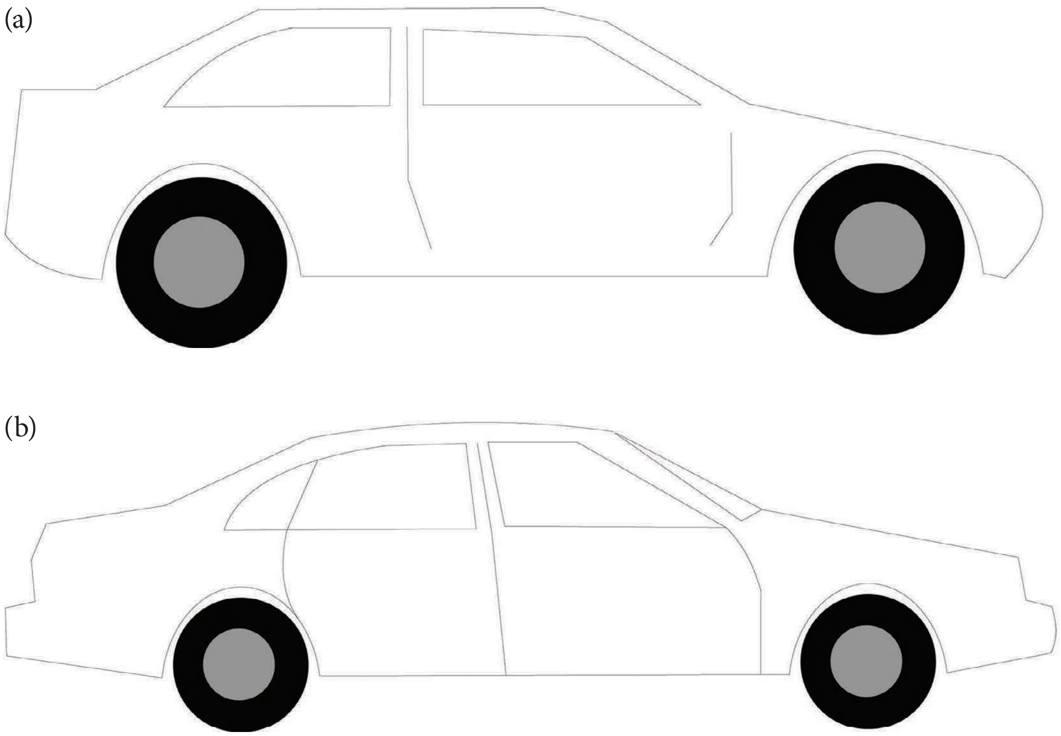


Figure 4.7 Investigators can use pre-drawn vehicle templates to help document the overall condition of vehicles as well as being used to more easily notate where different items of evidence were recorded from a vehicle. Panel (a) shows a two-door sedan, (b) a four-door sedan.

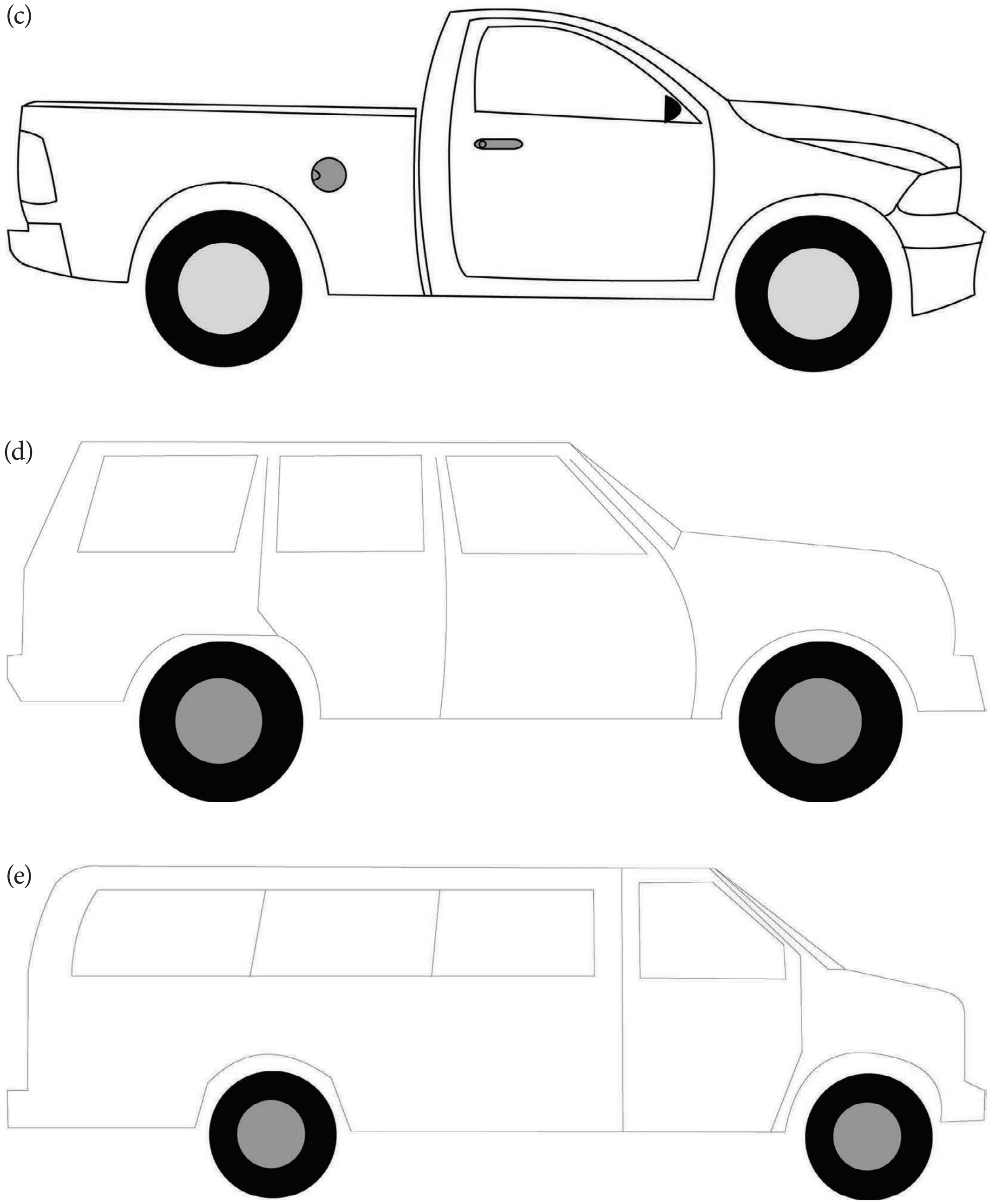


Figure 4.7 (Continued) Panel (c) a pick-up truck, (d) a sports utility vehicle, and (e) a van.

forms and templates to fit their own work and make them amenable to their own department forms and requirements. In the end, it is about recording a complete record of the vehicle's examination and the use of preformatted forms and templates is just a way to offer assistance and ensure that all-important information is recorded. It is always good to have a plan. Similar to what is said about military missions, if one fails to plan, then they should plan to fail. A well-equipped investigator is much better prepared to complete a competent examination. Proper organization is key to an efficient operation, and the investigator should keep a supply of all their preferred forms and templates. It is recommended that these forms and templates be stored in some sort of tray or folder system that allows the investigator quick and easy access to them while working on a vehicle. Of course, an evidence technician can draw their own templates and record their own notes, but these forms and templates can help them to work smarter, not harder.

Scale Diagrams

"Scale" diagrams are commonly completed at more serious crime scenes. There should be no difference when it comes to processing a vehicle used in more serious criminal acts. Diagrams are extremely useful as a visual representation of the processed vehicle and where evidence was located. This is especially true when diagramming a vehicle that has suffered multiple bullet strikes. A diagram is a great way to show the trajectories of fired bullets. Diagrams can also be of great assistance in court when it comes time to testify about one's findings during a vehicle's examination. Diagrams are helpful in showing important details about the vehicle all at once, something that photographs cannot always do. Vehicle diagrams are typically drawn from either the birds-eye or overhead view and the side or profile view. Both diagrams can be especially helpful when sitting on the witness stand and one is explaining where evidence was found, or for example, how the path of a fired bullet passed through a car. Diagrams can show a graphical representation of a bullet's trajectory in a very clear and concise manner. Photographs also have tremendous value in testifying, but a diagram can be much cleaner and not have distracting backgrounds, such as disturbing bloodstains and excessive vehicle damage.

Many crime scene units are well equipped and have computer-aided design (CAD) programs that already have a catalog of vehicles to select from. CrimeZone and CrashZone® are two such programs, and they possess a full library of almost every vehicle body style that can be imagined. A matching vehicle's body style can be selected, scaled to the proper size, and placed into one's diagram. Having a CAD program does make the task of diagramming a vehicle much easier, but not everyone will have that luxury. Other investigators may have to draw vehicles by hand. Thankfully, vehicles are not as difficult to draw as full-blown crime scenes. In addition, the drawings do not have to be masterpieces of art. They simply need to represent the basic body style of the examined vehicle.

If an investigator has access to a CAD program, then there should not be any reason not to draw a diagram of the vehicle. For those who are drawing by hand, there is an alternative. Most agencies or individuals will have Microsoft PowerPoint on at least one computer or be able to access Google Slides that can be used to make basic crime scene drawings. PowerPoint even has a feature that places a ruler along two sides of the drawing surface and the ruler's feature can be used to "scale" the vehicle being drawn. On the PowerPoint screen, there is a Tool Bar at the top of the screen and if one left-clicks on the "View" tool, it will open up another set of available tools. One of those is a check box with the word "Ruler" next to it. A left-click on the check box will insert a ruler along the slide's perimeter. The evidence technician can import an already drawn or other vehicle depiction into the program or draw their own. The vehicle can then be adjusted to fit the desired scale. With standard letter size paper being 8.5" by 11" and most vehicles being somewhere between 15' and 20' in length, a good basic scale is 1" for every 2'. Of course, the investigator can tweak this ratio to fit their particular need but 1" for every 2' is a good starting point. PowerPoint is a versatile program but it suffers in one aspect and that is it is not conducive to drawing accurate bullet strike angles. If one does not have a quality CAD program, the documentation of bullet strikes is best done by hand.

Hand drawing a vehicle can be accomplished with any number of drafting tools available at hobby stores or office supply stores. A standard ruler and a protractor are basic necessities. If one's penmanship is not the greatest, these same stores sell lettering stencils as well. Remember, hand drawings do not have to be overly complicated and a basic outline of the vehicle should suffice (Figure 4.8). Hand drawing vehicles damaged by gunfire is sometimes a better choice over the PowerPoint option because the impact angles can be more accurately drawn using a protractor and transferring the measured horizontal impact angles right onto the paper.

Regardless of whether an evidence technician is using a CAD program or drawing by hand, some standard pieces of information are required on vehicle or crime scene diagrams. Each agency is likely to have their own take on what is required on their

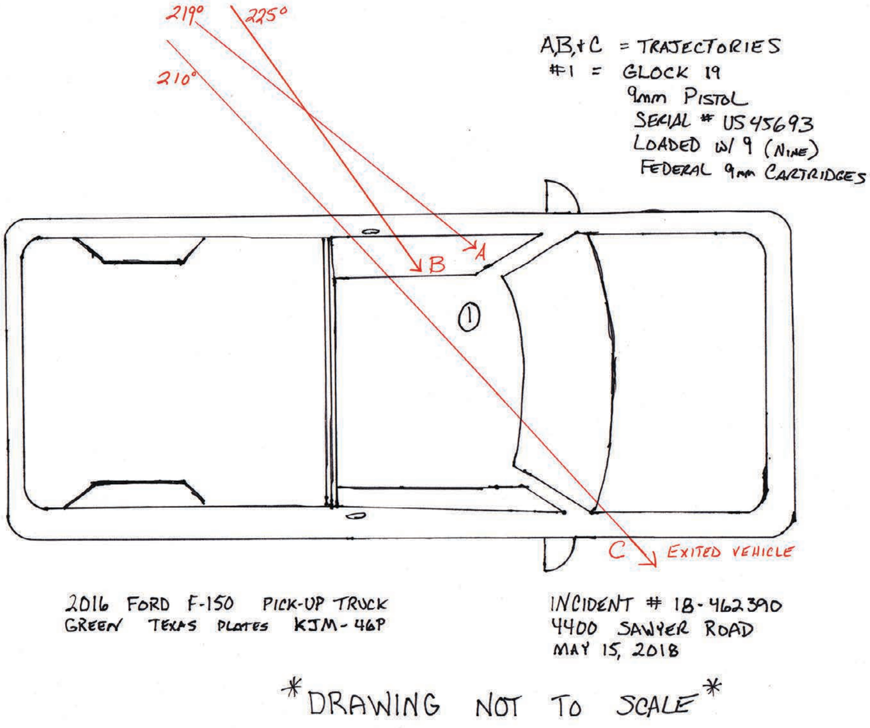

219°
225°
210°
A,B,+C = TRAJECTORIES
#1 = GLOCK 19
9mm PISTOL
SERIAL # US45693
LOADED W/ 9 (NINE)
FEDERAL 9mm CARTRIDGES
A
B
①
C
EXITED VEHICLE
2016 FORD F-150 PICK-UP TRUCK
GREEN TEXAS PLATES KJM-46P
INCIDENT # 18-462390
4400 SAWYER ROAD
MAY 15, 2018
DRAWING NOT TO SCALE

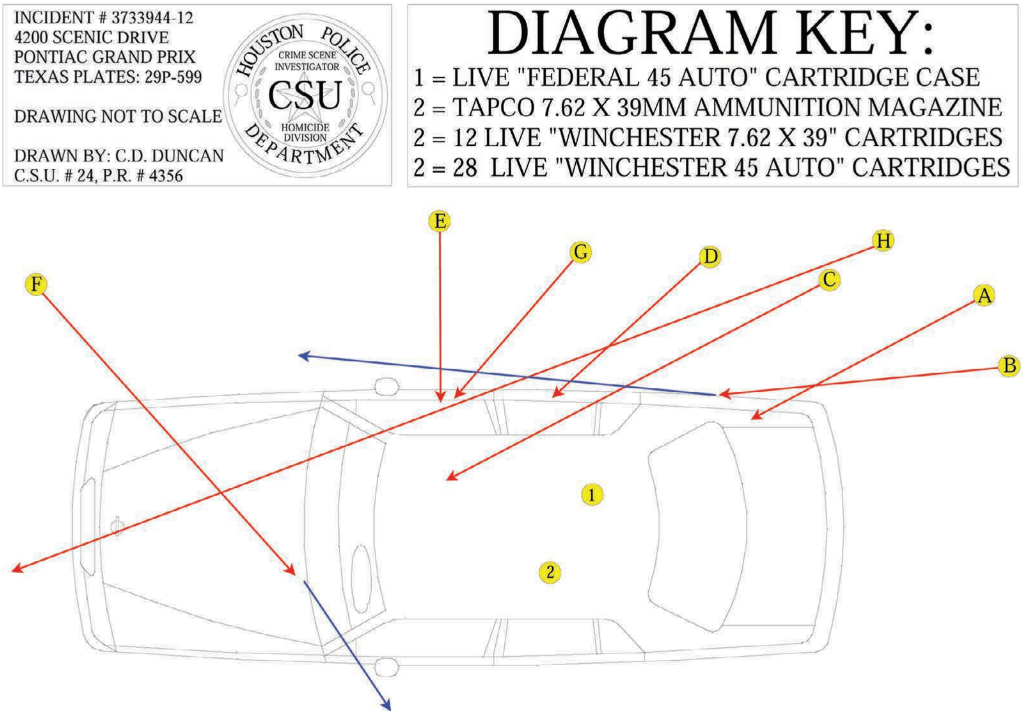
Figure 4.8 A hand-drawn vehicle does not have to be overly detailed, but the important aspects of the vehicle should still be clearly identifiable. Drawings done by hand may be more rudimentary in appearance, but by using drawing and lettering stencils they can still be professional-looking.

drawings, but most will have some form of the following information somewhere on the document:

- Title box (case information)
- Drawn by:
- "Not to Scale" or a reference scale
- Diagram key
- Reference point (if measurements are included)

The case information should include the incident or case number, the location, and date of the original incident. Some investigators might wish to have the date the diagram was created instead of the original offense date and that is up to each investigator. The title box should also include an identification of the vehicle, like 2016 Subaru Forrester (TX/ABC-1234). The investigator creating the drawing should be identified in the finished diagram. In reference to the diagram's scale, the drawing should be measured and drawn as close to scale as possible. Many agencies prefer to have a "Not to Scale" statement printed on the form instead of a reference scale. Technically speaking, if everything was to perfect scale, one would not be able to even see a fired cartridge case or a small bloodstain in a true scale diagram, because their representation on paper would be so small as to not be visible. Therefore, even though the diagrams are drawn to scale, placing a "Not to Scale" statement on the drawing is recommended. When it comes time to testify in court, the investigator can explain the reasoning for having the "Not to Scale" disclaimer and ensure the jury that the drawing is in proportion and/or perspective. A diagram key identifying the recovered evidence or important features of the examination is valuable for the viewer to understand what they are looking at. The final item that should be on the diagram is the identification of a reference point for any included measurements. The identification of a reference point is only needed when measurements are included in a diagram. The placement of all these items is up to each investigator but should be placed in a way that is appealing to the eye, logically organized, and easily understood (Figure 4.9).

As previously stated, a reference point is used to measure a vehicle using rectangular coordinates. Triangulation could also be used, but because of the rectangular shape of the vehicle, rectangular coordinates are the more logical choice. Using rectangular coordinates, the measurements are recorded right to left or left to right and front to back or back to front. Because vehicles are rarely perfectly square on their corners, which would be the logical reference points, the investigator needs to locate a reference point that is not physically on the vehicle (Figure 4.10). The evidence technician should choose which corner of the vehicle will be the reference point and lay one tape measure on the floor along the long axis of the vehicle and one tape measure along the short axis of the vehicle. The tape measures should be directly below the vehicle's outside edge on the two chosen sides because where these tape measures intersect will become the reference point. Setting the zero or start point of the tape measures at the point where the two tape measures intersect and leaving the tape measures on the floor will allow the investigator to reference them while recording all the evidentiary measurements. One final recommendation, when an investigator creates a diagram with measurements, those measurements can end up cluttering the drawing's presentation. It is important to have that level of detail in one diagram,


INCIDENT # 3733944-12
4200 SCENIC DRIVE
PONTIAC GRAND PRIX
TEXAS PLATES: 29P-599

DRAWING NOT TO SCALE

DRAWN BY: C.D. DUNCAN
C.S.U. # 24, P.R. # 4356

DIAGRAM KEY:
1 = LIVE "FEDERAL 45 AUTO" CARTRIDGE CASE
2 = TAPCO 7.62 X 39MM AMMUNITION MAGAZINE
2 = 12 LIVE "WINCHESTER 7.62 X 39" CARTRIDGES
2 = 28 LIVE "WINCHESTER 45 AUTO" CARTRIDGES

Figure 4.9 Just like a crime scene diagram, a vehicle's diagram assists the viewer in understanding the placement and orientation of evidence found on and in a vehicle. Although the diagram was drawn to scale, including the angles of the bullet strikes, notice that the diagram shows a "Not Drawn to Scale" disclaimer.

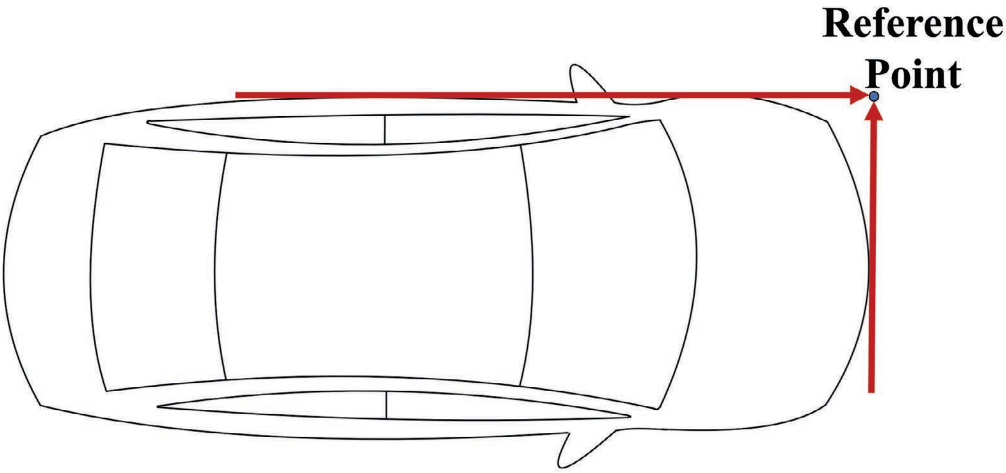


Figure 4.10 When measuring automobiles, a reference point is rarely going to be on the physical corner of the vehicle, but instead it will be at an imaginary point in space on a chosen corner of the vehicle. The investigator should draw a straight line along the long axis and the short axis of the vehicle. The point at which these lines intersect will become the actual reference point.

but some prosecutors prefer the base diagrams that do not have all the numbers and added detail. Therefore, investigators should create a pair of vehicle drawings, one base drawing with the basic evidence and one more detailed drawing with all the measurements and added detail. The prosecutor can then choose the diagram they are most comfortable with using in a trial.

In conclusion, vehicle diagrams, whether they are to scale or not, are an excellent way to put some perspective and relationship information into a consolidated picture form. Drawings are easily discernable and can assist the viewer with understanding complicated information like the impact angles of fired bullets. When showing such important details of impact angles, vehicle diagrams should be carefully measured and accurate angles depicted on paper. However, if an evidence technician is simply wanting to show the location of recovered fingerprints or DNA swabbing sample collections, then the need for a scale drawing is not as great, but diagrams are a great way to supplement the written report and will be appreciated by everyone from case investigators to the state's prosecutors.

Report Writing

Law enforcement agencies differ in size (manpower) and resources. However, there is one constant across every single agency and that is the necessity of written offense reports. Departments will have a variety of software programs that record and manage reports. Agencies will also have prescribed formats that they desire their reports to be written in. Because the processing of a vehicle involved in a crime is most likely going to be a supplemental type report and not the primary offense report, the author is likely to have a little more latitude in how their report is formatted, at least the narrative portion of the report. It is this narrative portion of the report that will be discussed here. There are measures that every author might consider to help make their reports more logical and understandable.

Smaller agencies may have the same detective working a criminal case from start to finish, including the processing of a vehicle. Larger agencies may have one or two persons assigned to the processing of vehicles and that is their sole job, not having other responsibility in the case. Regardless of which category someone falls into, the report is written not only for the author but also for any of a number of other readers. When writing a report, one should think about where the report might end up. Ultimately, the report is likely to end up in a court of law. However, before it gets there, the report is going to be used by investigators to corroborate witness statements and to support or refute theories on what occurred. The report may be used to seek charges in front of a grand jury. If those charges are accepted, then the report will be used at trial. Even if the case does not go to trial and is plead out, it still means the report is going to be read by attorneys on both sides. A defense attorney does not want to see a well-written and thorough report that they will have difficulty attacking in a trial. However, a sloppy and inarticulate report will give defense attorneys potential areas to argue reasonable doubt with the jury. An investigator's written report may also become a key part of an appeal and may be scrutinized in an appellate court. In other cases, such as officer-involved shootings, an investigator's report may be critically reviewed in a civil trial where the burden of proof is much less than a criminal trial. In the end, a report reflects on the author and whether it is just an investigator's supervisor or the chief prosecutor in a criminal court that reads the report, one has the obligation to create a logical, sound, and articulate report that any reader can understand.

Because the processing of a vehicle is generally a secondary task apart from the primary crime scene, the report is likely considered a supplement report and the format maybe a little more flexible than the original case report. Investigators must follow their agency's protocols and procedures, but having a logical progression to the report will help with clarity. Everything that was recorded in an investigator's notes needs to find a home in the supplement report. For example, the following categories of tasks can be used to provide a logical framework to the report:

- Introduction
- Vehicle description, condition, and contents
- Investigator's actions or functions
- Evidence disposition

Each category will contain their logical section's information. In addition, there are likely to be subsections for the different types of investigations encountered, such as bloodstains and ballistic-related investigations. Some information may be duplicated in different sections, but this is a good thing. For example, in the investigator's actions, evidence technicians will describe how the property was collected and where it was submitted into evidence. Then, the evidence will be listed again in the evidence disposition section. Although the repetitive nature of this sounds unnecessary, the clarity and ease of finding specific information are improved. Some reports may be quite lengthy and if it was completed in paragraph form, then finding one particular piece of evidence or point of interest would be quite difficult. It is helpful to break up information in bite-size chunks instead of cramming information into one long convoluted paragraph.

The introduction section is like a newspaper article's lead. It should contain the who, what, where, when, and how of the investigation. Basically, it should explain to the reader what the purpose of the supplement report is. Specifically, it includes who processed the vehicle, where it was processed, when it was processed, and how the vehicle came to be processed. The "what" of course will be the full identification of the vehicle being examined. The introduction would also be a good place to document how the investigator gained legal access to the vehicle, either by consent or via a search warrant. "How" the vehicle was specifically processed will be more fully recorded in the functions section. Information that might also be included in the opening paragraph would be the identity of the case investigator if that person is different from the person completing the vehicle's examination. The introduction section is generally brief and touches on how the vehicle came to the attention and custody of the evidence technician. One does not have to go into great detail in the introduction, as that will certainly come later in the report.

The vehicle summary section is where the full description of the vehicle takes place. One may feel comfortable writing in paragraph form, but complete case files can be thousands of pages of information containing everything from reports from officers, investigators, laboratory personnel, and medical examiners. As a result, it is recommended that some information be placed in bullet points and those first bullet point items can be found in the scene or vehicle summary section. The vehicle's summary can be further broken up into two distinct subsections, including the following:

- Identification of vehicle
  - Make
  - Model
  - License plate number
  - Vehicle identification number
  - Color
  - Body style
- Vehicle's overall condition
  - Specific information about damage and condition
  - Separate section detailing the damage to the vehicle that is related to the crime being investigated
  - Any stickers or placards for registration, tax, parking, work, school, etc.
  - Contents and property found in the vehicle

All the information recorded in the investigator's notes about the vehicle's condition and property contents should find a home in one of these subsections. This is a great place to make a listing of information in bullet form. Instead of writing a long drawn-out sentence itemizing information, one can make an easy-to-read bullet point list of damage, property, etc. Reading a report with bullet lists is much easier to understand than in paragraph form and this is helpful when searching through a report for one specific detail or trying to recall some specific aspect of the vehicle while testifying in court and trying to find the information in one's report on the witness stand.

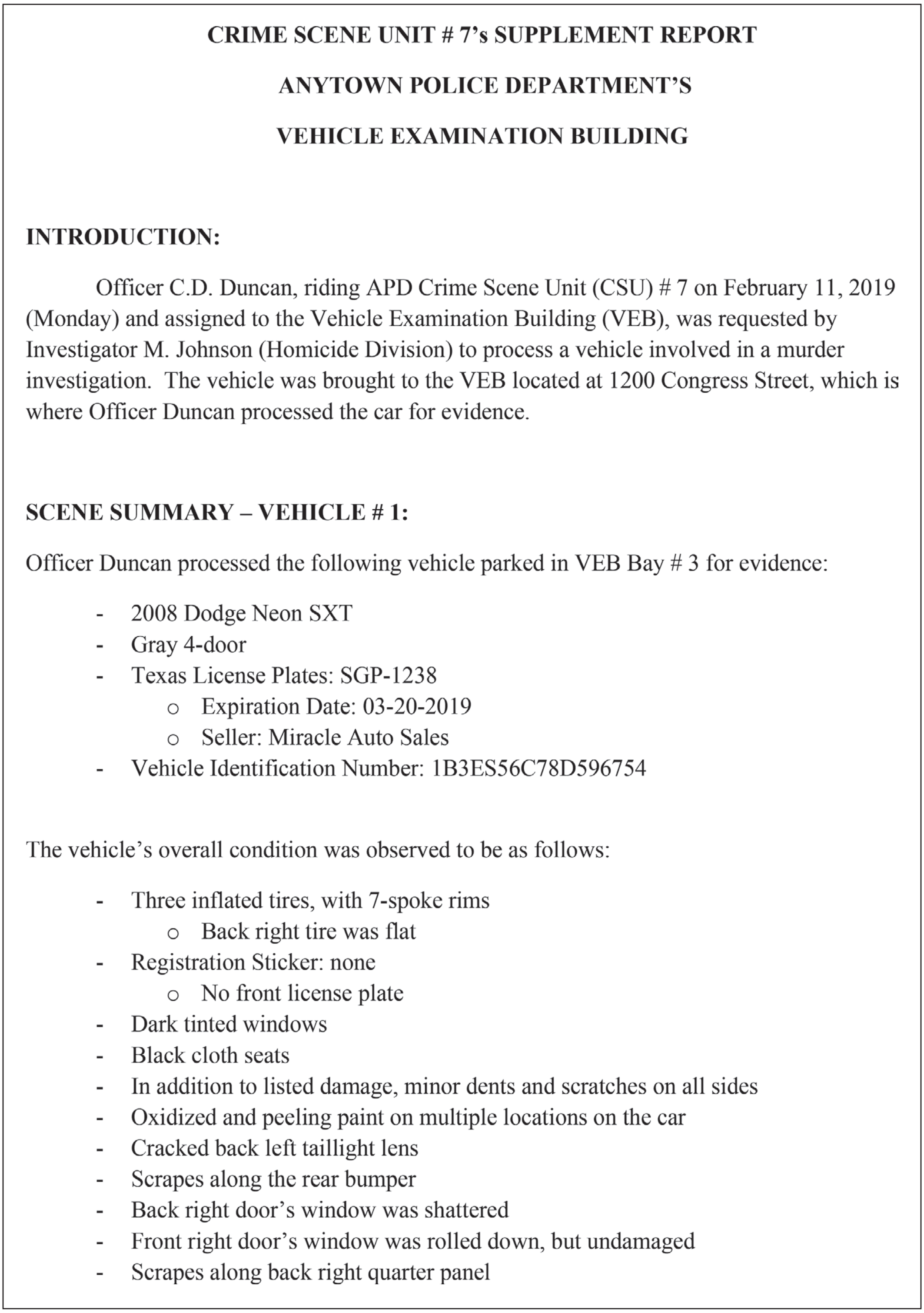
Listing information with bullet points is especially useful in documenting complex material like bullet strikes and bloodstain information. Organizing the information in a logical manner will assist those who are reading the report, but who may not have the expertise in vehicle processing that the evidence technician has. Damage to a vehicle that was a direct result of the crime or that has a bearing on the investigation should be set apart from the typical dents and scratches frequently found on vehicles. Bullet strikes are an excellent example of where listing the information in a logical order can help the reader. Review the following example for the written description of a fired bullet's trajectory:

- Impact Site B-1 and the trajectory of Fired Bullet "B":
  - Fired Bullet B perforated the back-left quarter panel at B-1 and B-2. The fired projectile impacted the back-left wheel-well at B-3 and deflected away from the vehicle at the crime scene. The fired bullet was not recovered. The following approximate measurements were recorded regarding Impact Site B-1:
    - 8"–10" back from the front edge of the car
    - 0"–0" right from the left edge of the car
    - 2"–6" up from the ground
    - 258°–78° horizontal angle of impact (back to front, left to right)
    - 3° down vertical angle of impact

This format or something similar to an investigator's preference should be used for each and every bullet strike or other specific piece of information being detailed. Notice how the information begins with a written description of the fired bullet's flight path through the vehicle. In this particular case, the fired bullet was not recovered. However, if it was, then its recovery should be noted in the written summary. The measurements recorded in the investigator's notes are placed into the bulleted list of information, and each set of individual measurements should be given a new line on the list. If a particular measurement was unable to be recorded, that information is still recorded, and a brief statement as to why it could not be accurately measured. Organizing a vehicle's processing into words is an acquired skill, but one that is a necessity.

The third section in a basic supplement report is what the investigator did during the processing of the vehicle. This information should begin with a simple restating of the investigator's involvement in the case or some opening statement that reinforces the assignment given to the investigator. After a couple of these introductory statements, the report can delve into the investigator's actions. A logical approach to the writing would be to follow the logical steps taken in the investigation, beginning with the photographic documentation of the vehicle and ending with the submission of recovered property into evidence or wherever the evidence was secured. The information written in this section should be in full and complete detail. For example, when documenting the fingerprint processing of the vehicle, the location details written on each fingerprint lift card should be copied into the report. Yes, the print locations can be listed in bullet form. Other information that might be included would be if latent prints were not recovered and a statement as to why they were not recovered. Sometimes it is just as important to document why something was not found or recovered than to what was recovered because one is bound to be asked why something was not recovered by the case investigator or a defense attorney at trial. And since trials may occur a year or two after the processing of a vehicle, the likelihood of remembering such a small detail may not be easily recalled. Therefore, having that information permanently recorded is vital. This philosophy of completeness is applicable to every evidence technician's actions and choices in the processing of a vehicle. After a quality documentation of the investigator's efforts in processing the vehicle, a concluding statement about the investigator's role in the investigation should be included. For example, is the evidence technician's job concluded with the processing of the vehicle or is there something in the future that will be worked regarding the case investigation. One of the final statements should also include the vehicle's disposition, as well as the evidence. The evidence statement can be a single-broad statement because the final section of the report covers the specific dispositions of all recovered evidence and/or property.

The final section of a supplement report should be a listing of everything recovered from the vehicle, including photographs. The disposition statements should list the different types of evidence and a short statement as to where they were submitted into evidence. This final section is repetitive of information written down in the investigator's actions section immediately prior, but this is just a synopsis statement that is meant to be easily reviewed without having to search through lengthy superfluous text. A final concluding statement to this evidence disposition section might include a statement confirming that the "care, custody, and control of all recovered property from the time of collection until the time of submission into evidence" was emphatically stated. An example of a supplement report regarding the processing of a vehicle is given in Figure 4.11.



CRIME SCENE UNIT # 7's SUPPLEMENT REPORT

ANYTOWN POLICE DEPARTMENT'S

VEHICLE EXAMINATION BUILDING

INTRODUCTION:

Officer C.D. Duncan, riding APD Crime Scene Unit (CSU) # 7 on February 11, 2019 (Monday) and assigned to the Vehicle Examination Building (VEB), was requested by Investigator M. Johnson (Homicide Division) to process a vehicle involved in a murder investigation. The vehicle was brought to the VEB located at 1200 Congress Street, which is where Officer Duncan processed the car for evidence.

SCENE SUMMARY – VEHICLE # 1:

Officer Duncan processed the following vehicle parked in VEB Bay # 3 for evidence:

- 2008 Dodge Neon SXT
- Gray 4-door
- Texas License Plates: SGP-1238
    - Expiration Date: 03-20-2019
    - Seller: Miracle Auto Sales
- Vehicle Identification Number: 1B3ES56C78D596754

The vehicle's overall condition was observed to be as follows:

- Three inflated tires, with 7-spoke rims
    - Back right tire was flat
- Registration Sticker: none
    - No front license plate
- Dark tinted windows
- Black cloth seats
- In addition to listed damage, minor dents and scratches on all sides
- Oxidized and peeling paint on multiple locations on the car
- Cracked back left taillight lens
- Scrapes along the rear bumper
- Back right door's window was shattered
- Front right door's window was rolled down, but undamaged
- Scrapes along back right quarter panel

Figure 4.11 Original and supplemental offense reports must be written logically, easy to read, and organized in a way that the reader knows exactly what occurred and did not occur during the vehicle's processing.

- Cracked windshield
- Scrapes along the front bumper
- Broken front right fog light lens
- Scrapes and dents on front left quarter panel
- A large chunk of wood wedged into the bottom left door
    - Dented threshold below front and back left side doors
- Front left door’s window shattered

In addition to the above listed damage, Officer Duncan documented eight bullet strikes to the Dodge Neon. The Impact Sites were labeled “A” through “H” in the crime scene photographs. The Impact Sites were documented and measured as follows:

- Impact Site A:
    - Fired Bullet A perforated the back trunk lid (A-1 & A-2). The fired bullet continued across the trunk and perforated the back left seat (A-3 & A-4). The projectile continued across the back seat and perforated the front left seat (A-5 & A-6). The fired bullet passed through the front seat, but no corresponding fired projectile was found or corresponding damage to the vehicle. Fired Bullet A was not recovered. The following approximate measurements were recorded for Impact Site A-1:
        - 14’-0” forward from the back edge of the car
        - 3’-2” left from the right edge of the car
        - 3’-1” up from the ground
        - 167° - 347° horizontal angle of impact (back to front, slight right to left)
        - 4° down vertical angle of impact

- Impact Site B:
    - Fired Bullet B perforated the back right tire’s wheel well (B-1 & B-2). The projectile next perforated the back right seat and entered the passenger’s compartment of the vehicle (B-2 & B-3). The fired bullet passed across the back seat and grazed the right side of the front left seat (B-5). The projectile did not have a corresponding impact site in the front of the vehicle. Fired Bullet B was not recovered. The following approximate measurements were recorded for Impact Site B-1:
        - 10’-9” forward from the back edge of the car
        - 1’-2” left from the right edge of the car
        - 1’-9” up from the ground
        - 145° - 325° horizontal angle of impact (back to front, right to left)
        - 3° down vertical angle of impact

Figure 4.11 (Continued)

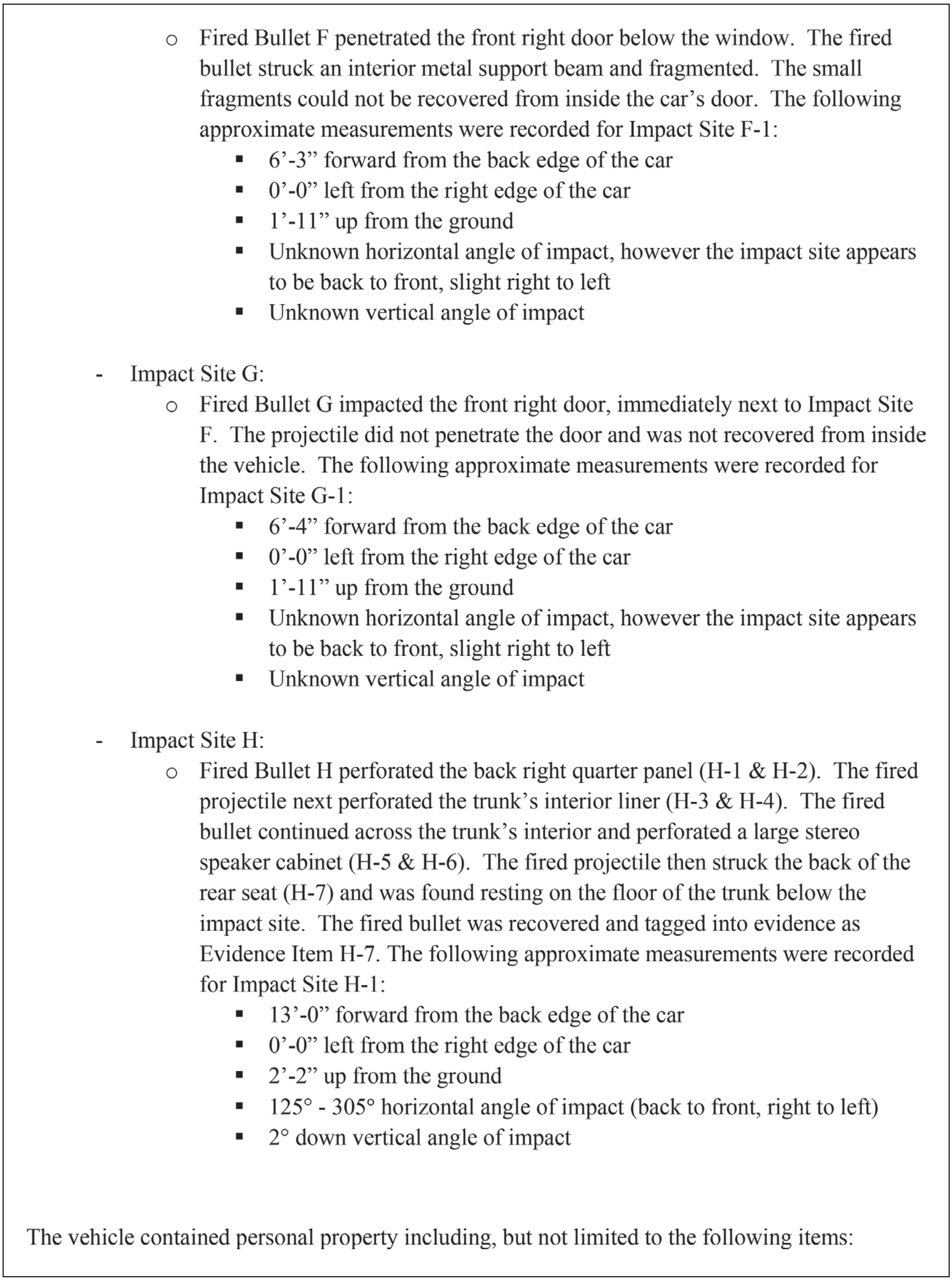
- Impact Site C:
    - Fired Bullet C perforated the back right door's window (C-1 & C-2). The fired bullet travelled across the passenger's compartment and perforated the front left door's window (C-3 & C-4). Fired Bullet C exited the vehicle and was not recovered. The following approximate measurements were recorded for Impact Site C-1:
        - 10'-1" forward from the back edge of the car
        - 0'-5" left from the right edge of the car
        - 3'-8" up from the ground
        - 124° - 304° horizontal angle of impact (back to front, right to left)
        - 4° down vertical angle of impact

- Impact Site D:
    - Fired Bullet D perforated the back right door (D-1 & D-2). The fired bullet then perforated the front right seat's seat back (D-3 & D-4). The projectile was still moving in a downward angle and perforated the front right seat's bottom cushion (D-5 & D-6). The fired bullet entered the center console below the front dashboard (D-7). The fired bullet continued into and behind the dashboard and could not be recovered without causing severe damage to the dashboard. The following approximate measurements were recorded for Impact Site D-1:
        - 9'-1" forward from the back edge of the car
        - 0'-0" left from the right edge of the car
        - 1'-5" up from the ground
        - 158° - 338° horizontal angle of impact (back to front, right to left)
        - 4° down vertical angle of impact

- Impact Site E:
    - Fired Bullet E impacted the front right door below the window. The projectile did not penetrate the door and was not recovered from inside the vehicle. The following approximate measurements were recorded for Impact Site E-1:
        - 4'-11" forward from the back edge of the car
        - 0'-0" left from the right edge of the car
        - 1'-1" up from the ground
        - Unknown horizontal angle of impact, however the impact site appears to be back to front, slight right to left
        - Unknown vertical angle of impact

- Impact Site F:

Figure 4.11 (Continued)



- Fired Bullet F penetrated the front right door below the window. The fired bullet struck an interior metal support beam and fragmented. The small fragments could not be recovered from inside the car's door. The following approximate measurements were recorded for Impact Site F-1:
    - 6'-3" forward from the back edge of the car
    - 0'-0" left from the right edge of the car
    - 1'-11" up from the ground
    - Unknown horizontal angle of impact, however the impact site appears to be back to front, slight right to left
    - Unknown vertical angle of impact

- Impact Site G:
    - Fired Bullet G impacted the front right door, immediately next to Impact Site F. The projectile did not penetrate the door and was not recovered from inside the vehicle. The following approximate measurements were recorded for Impact Site G-1:
        - 6'-4" forward from the back edge of the car
        - 0'-0" left from the right edge of the car
        - 1'-11" up from the ground
        - Unknown horizontal angle of impact, however the impact site appears to be back to front, slight right to left
        - Unknown vertical angle of impact

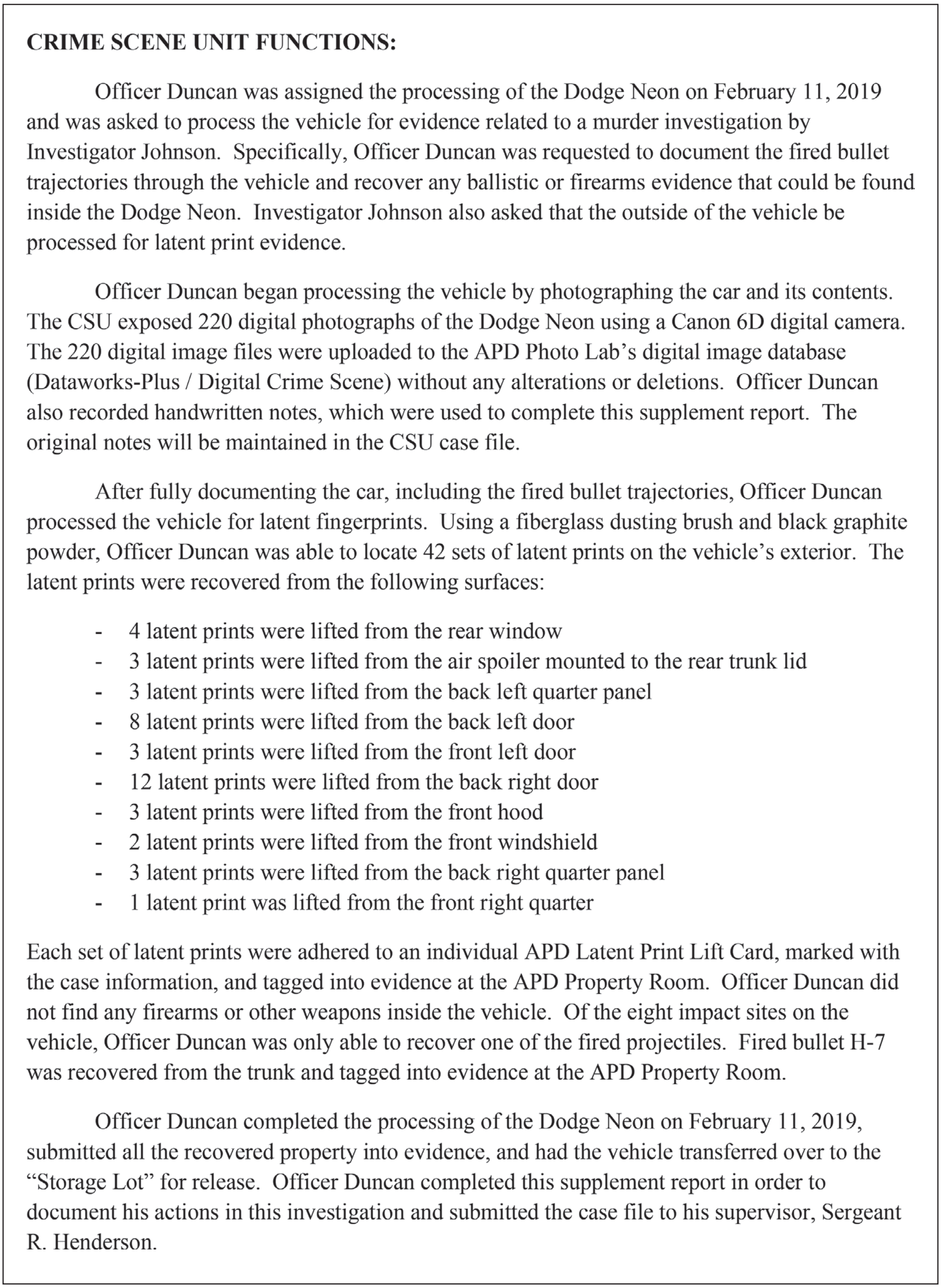
- Impact Site H:
    - Fired Bullet H perforated the back right quarter panel (H-1 & H-2). The fired projectile next perforated the trunk's interior liner (H-3 & H-4). The fired bullet continued across the trunk's interior and perforated a large stereo speaker cabinet (H-5 & H-6). The fired projectile then struck the back of the rear seat (H-7) and was found resting on the floor of the trunk below the impact site. The fired bullet was recovered and tagged into evidence as Evidence Item H-7. The following approximate measurements were recorded for Impact Site H-1:
        - 13'-0" forward from the back edge of the car
        - 0'-0" left from the right edge of the car
        - 2'-2" up from the ground
        - 125° - 305° horizontal angle of impact (back to front, right to left)
        - 2° down vertical angle of impact

The vehicle contained personal property including, but not limited to the following items:

Figure 4.11 (Continued)

- Trash
- Keys were in the ignition
- In-dash car stereo
- Radar detector
- Air fresheners
- Plastic bead necklace
- USB Charger and cords
- Hats
- Ashtray
- Assorted papers
- Compact disks
- Shoes
- Sandals
- Assorted coins
- Newport cigarettes
- Small hand tools
- Matches
- Flosser
- Cologne
- Aspirin
- Hair brush
- Child's toys
- Car speakers
- Coat
- Amplifier
- Diapers
- Assorted food items
- Assorted cleaning supplies
- School papers and supplies
- Valentine chocolates
- Jumper cables
- Personal alarm
- Purse with papers and child's toys
- Plastic bowls
- Wallet with cards (no cash)
    - Social Security Card
        - Frederick Lamont Smith
        - 111-35-8559

Figure 4.11 (Continued)



CRIME SCENE UNIT FUNCTIONS:

Officer Duncan was assigned the processing of the Dodge Neon on February 11, 2019 and was asked to process the vehicle for evidence related to a murder investigation by Investigator Johnson. Specifically, Officer Duncan was requested to document the fired bullet trajectories through the vehicle and recover any ballistic or firearms evidence that could be found inside the Dodge Neon. Investigator Johnson also asked that the outside of the vehicle be processed for latent print evidence.

Officer Duncan began processing the vehicle by photographing the car and its contents. The CSU exposed 220 digital photographs of the Dodge Neon using a Canon 6D digital camera. The 220 digital image files were uploaded to the APD Photo Lab's digital image database (Dataworks-Plus / Digital Crime Scene) without any alterations or deletions. Officer Duncan also recorded handwritten notes, which were used to complete this supplement report. The original notes will be maintained in the CSU case file.

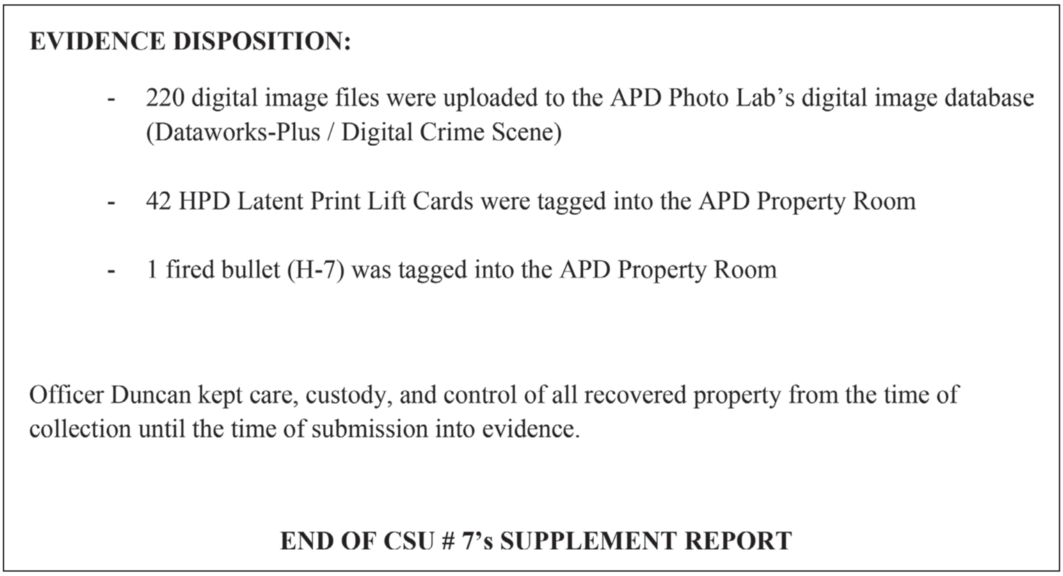
After fully documenting the car, including the fired bullet trajectories, Officer Duncan processed the vehicle for latent fingerprints. Using a fiberglass dusting brush and black graphite powder, Officer Duncan was able to locate 42 sets of latent prints on the vehicle's exterior. The latent prints were recovered from the following surfaces:

- 4 latent prints were lifted from the rear window
- 3 latent prints were lifted from the air spoiler mounted to the rear trunk lid
- 3 latent prints were lifted from the back left quarter panel
- 8 latent prints were lifted from the back left door
- 3 latent prints were lifted from the front left door
- 12 latent prints were lifted from the back right door
- 3 latent prints were lifted from the front hood
- 2 latent prints were lifted from the front windshield
- 3 latent prints were lifted from the back right quarter panel
- 1 latent print was lifted from the front right quarter

Each set of latent prints were adhered to an individual APD Latent Print Lift Card, marked with the case information, and tagged into evidence at the APD Property Room. Officer Duncan did not find any firearms or other weapons inside the vehicle. Of the eight impact sites on the vehicle, Officer Duncan was only able to recover one of the fired projectiles. Fired bullet H-7 was recovered from the trunk and tagged into evidence at the APD Property Room.

Officer Duncan completed the processing of the Dodge Neon on February 11, 2019, submitted all the recovered property into evidence, and had the vehicle transferred over to the "Storage Lot" for release. Officer Duncan completed this supplement report in order to document his actions in this investigation and submitted the case file to his supervisor, Sergeant R. Henderson.

Figure 4.11 (Continued)



EVIDENCE DISPOSITION:

- 220 digital image files were uploaded to the APD Photo Lab's digital image database (Dataworks-Plus / Digital Crime Scene)
- 42 HPD Latent Print Lift Cards were tagged into the APD Property Room
- 1 fired bullet (H-7) was tagged into the APD Property Room

Officer Duncan kept care, custody, and control of all recovered property from the time of collection until the time of submission into evidence.

END OF CSU # 7's SUPPLEMENT REPORT

Figure 4.11 (Continued)

Writing Better Offense Reports

Writing quality reports is a well-respected skill set. Evidence technicians and investigators of all types are frequently chosen through a selection process and part of that process likely involves providing a writing sample. It is very important to develop a clear, concise, and logical writing style, but one that also fits with the investigator's individual style. Individual agencies will have their own particular requirements when it comes to report writing. For example, agencies will have a requirement or at least a preference whether a report is written in first person or third person. The current trend is writing offense reports in first person. In addition, how reports are written, whether it is a report writing program written specifically for the agency or if the investigator can use a standard computer software program, like Microsoft Word®. How an offense report is formatted and prepared is beyond the control of the individual investigator, but how the report reads and how it sounds to the reader is completely up to the author of the report.

There are a few hints that can be offered to help a writer create a clearer and more organized written report. Just like when one was in school, the mantra that spelling and grammar count lives on. Most writing software programs have some form of spell-check and may have minor grammar check features and authors should use them. There is nothing wrong with having a dictionary available, especially now that pretty much anything an investigator wishes to know is at their fingertips via their smartphone. Investigators should write in full sentences and paragraph form. This does not preclude the ability of investigators to use bullet-point lists to highlight specific items or make an enumerated list of something much clearer in the report. Offense reports that are filled with run-on sentences and are just one super-long paragraph are limited in value and are very tough to read. Authors should strive to keep sentences concise and break up the overall report into logically separated paragraphs.

Police should write in plain or easy-to-understand English and avoid police jargon when possible. However, there is an exception and that is when explaining technical aspects of one's investigation. A perfect example is when describing specific bloodstain patterns or trajectories. When detailing the more technical aspects of bloodstain pattern analysis and the author uses specific terminology, such as impact spatter or transfer stains, those words should be defined in the report when they are first used. This will help those readers that are not as knowledgeable in technical areas of police work. In addition, with the definitions placed right in the body of the report, any reader of the report is clear on the information being presented. In the end, anytime a term that might mean one thing to a casual observer, but another to a criminal investigator, then that term needs to be clearly defined in the body of a report.

Investigators should also avoid using abbreviations. Those investigators who graduated through the police ranks, often became accustomed to writing reports using a host of "accepted" abbreviations so that they could complete their reports quickly and return to their patrol duties. Unfortunately, this is not acceptable in more serious case investigations and even less serious investigations. Even if police supervisors, prosecutors, and other readers accept common abbreviations, it opens a door for defense attorneys to attack an investigator's whole body of work. Imagine the following exchange between a defense attorney and the evidence technician:

- *Attorney:* "Officer, did you write a complete and thorough report documenting your actions in this case?"
- *Officer*: "Yes, sir."
- *Attorney:* "Would you please read the sentence I have highlighted in your report please."
- *Officer*: "Officer Smith arrived at 1200 Main Street on November 1, 2019 at approximately 1400 hours."
- *Attorney:* "No sir, would you please read to the jury the exact wording you wrote in your report."
- *Officer*: "Off. Smith arr. at 1200 Main St. on Nov. 1, 19 at approx. 1400 hrs." (Enunciate the shortened words as they are written, not what they represent.)
- *Attorney:* "Why is your report written like this?"
- *Officer*: "It is just a shortcut." (Or any other answer that indicates that the report was not "complete and thorough.")
- *Attorney:* "Officer, where else in your investigation did you take shortcuts?"

No matter how one would answer the next to last question, the defense attorney is going to characterize the investigator's response as incomplete, lazy, or shoddy and say it contradicts with the investigator's claim they did a "complete and thorough" report. Even if a prosecutor gets a sustained objection to the defense attorney's characterization, the jury has heard it and the damage has been done. It does not take that much more effort to type out a few extra letters. Take the time and avoid the courtroom embarrassment. Acronyms can be used, but they should be identified the first time they are used and that is even with commonly known acronyms like the Federal Bureau of Investigation (FBI) and deoxyribonucleic acid (DNA).

Another important part of writing quality investigative reports is to stick to observable facts. Since the supplement reports being discussed here involve the processing of vehicles, the report's author should only write about their observations with the vehicle and actions taken during its processing. The evidence technician should receive some basic information about the case so that they know what to look for regarding the investigation. However, they should not become swayed in their work by any opinions or theories offered by the case investigator. The evidence and the vehicle should speak for themselves. Evidence technicians should try to avoid giving theories or opinions in their reports. However, there are times when opinions and theories are placed in a report, such as in reconstruction reports. Reconstruction reports are a special kind of report, but any theories and "expert" opinions are supported by facts found during the overall investigation. Furthermore, reconstruction reports are completed after all other reports, lab analyses, and witness statements have been made or collected. A report's author should be aware of any biases they may inadvertently develop because of information told to them by another. If an author keeps the report simply to what they saw and what they did, then they cannot go wrong.

Conclusion

If investigators will keep one thing in mind when recording notes, creating diagrams, and writing reports, then they will surely be successful in their endeavors. The one thing to keep in mind is that everything they do can end up in a court of law. Nothing is more humbling than being embarrassed in court by a defense attorney ripping apart an investigator's body of work. There is no room in criminal investigations to be cavalier in one's work or to be taking shortcuts. An investigator is only as good as the work they produce. That work begins with the taking of quality notes. Using preformatted templates can help investigators remember the smaller details that may be inadvertently overlooked. Templates or formatted note pages also help keep one's notes organized and neat. Taking the recorded notes and turning them into a logical, well-organized offense report takes experience. An organized report requires that the report has a common-sense flow to it, moving from an introduction describing the reason one is processing a particular vehicle to a conclusion that will articulate the disposition of evidence, including the processed vehicle. The report should be written in paragraph form and have complicated concepts and lists of information be set apart in bullet-point listings. A report is much easier to read when information is not squished together in one long paragraph filled with run-on sentences. In the end, a professional report is organized, complete but concise, clear in thought, and offers observable facts, not opinions. And yes, spelling and grammar count.

Additional Readings

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Review Questions: The Documentation of Motor Vehicles

1. What should processing notes be written with?
   a. Ink pen
   b. Sharpieermanent marker
   c. Pencil
   d. Any of the above
2. When taking written notes, which statement is most accurate?
   a. Place all pertinent information in a concise form on one or two forms
   b. Record all information on pre-formatted forms
   c. Do not cram information together only to save space
   d. Notes do not have to be complete if the investigator has a good memory
3. An investigator's notes can be subpoenaed in court, even when the investigator has completed a thorough report.
   a. True
   b. False
4. Which ISO (International Organization for Standardization) standards is generally applicable to forensic laboratories that might include crime scene investigation units?
   a. 16050
   b. 17025
   c. 18250
   d. 19202
5. Which of the following would be placed in the "Body Style" box on an investigator's notes template page?
   a. Ford
   b. Mustang
   c. Two-door
   d. Blue and yellow
6. How would one describe the conversation between a criminal investigator and the evidence technician when discussing the processing of a vehicle?
   a. Collaboration
   b. Demanding
   c. Inept
   d. Vehement
7. What value does the use of preformatted forms and templates offer investigators?
   a. They help with organizing an investigator's examination
   b. They help ensure the investigator does not forget some small aspect of the investigation
   c. They help ensure a complete investigation
   d. All of the above

8. What does “charting” a firearm refer to?
   a. Drawing a picture of the firearm
   b. Placing the firearm into an evidence chart
   c. Recording how the weapon was loaded and chambered
   d. Checking the firearm’s serial number for a stolen status
9. What can be determined by noting what may or may not be inside of a firearm’s barrel?
   a. Whether or not the firearm had been fired
   b. If a recovered fired bullet came from the weapon
   c. If the firearm is loaded or not
   d. If the firearm’s safety was engaged or not
10. A semi-automatic pistol’s capacity is equal to the total number of cartridges found in the ammunition magazine.
    a. True
    b. False
11. Which of the following is not required on a scale drawing of a motor vehicle?
    a. Diagram key
    b. Title box with case information
    c. North arrow
    d. “Not to Scale” or a reference scale
12. A vehicle’s reference point is always found on a physical part of the vehicle.
    a. True
    b. False
13. Investigators are encouraged to use commonly understood abbreviations in their offense reports in order to keep them concise.
    a. True
    b. False
14. Investigators should always identify any acronyms on their first use in a report.
    a. True
    b. False
15. What should authors avoid putting in their offense or supplement reports?
    a. Observations
    b. Opinions
    c. Conditions
    d. Corroborations

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The Photographic Documentation of Vehicles

5

The photographic documentation of a vehicle involves much more than pointing and clicking a camera's shutter button. Understanding the basic concepts of photography and how a camera works is vital to the capture of accurate, properly focused, and well-illuminated evidentiary photographs. It takes practice to look at a composition, see the focus and lighting problems, and figure out a way to defeat such challenges. Photography is not only an art form but also a skill that requires practice to become competent. Photography should not be thought of as a box to mark off on some arbitrary checklist. Rather, it should be thought of an important part of the complete documentation and processing of a motor vehicle. In addition, photography of a vehicle's processing is not only simply documentation of the evidence found in and on the vehicle but also the documentation of the processing steps completed by the investigator. To ensure that a complete photographic record is obtained, the photographer must first understand basic photographic principles.

Any effort to photograph a crime scene begins prior to the vehicle's examination. In addition to making sure that all the necessary equipment is available, photographers must ensure that batteries are charged and that the equipment is in good working order. Some agencies have enough camera equipment so that all investigators have their own gear. However, other agencies do not have those same resources and investigators are forced to share equipment. Sharing photography equipment presents so many potential problems that it is recommended investigators belonging to cash-strapped agencies invest in their own photography gear. The headaches avoided by possessing one's own gear will far outweigh the cost.

Regardless of whether investigators share equipment, the next step is to ensure that the starting points or camera settings are correct and set as desired. Every subject's settings and composition have the potential to be different. One photograph may be recorded in monochrome, while the next photograph demands a small aperture, followed by a timed exposure of a luminol reaction. There is nothing worse than when an investigator believes he or she is photographing in an automatic exposure mode, not worrying about reading the exposure meter, only to realize later that all the photographs are overexposed or underexposed because the camera was not set as originally thought. This can easily occur; therefore, photographers must check all camera settings prior to starting any assignment.

Photographers should also get into the habit of routinely and periodically checking a camera's settings because they can be easily changed unintentionally in the course of a photographic assignment. On some camera models, it is quite easy to accidentally push a button or bump a dial without immediately recognizing that it had some effect on the recorded photograph's outcome. Some (not all) of the more important settings to make sure are properly set prior to and while working on a vehicle include the following:

- Image quality, compression, and RAW capture settings
- ISO setting

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- White balance, monochrome, or color selections
- Exposure (capture) mode
- Exposure and flash compensation settings

One good habit to develop is to reset all settings to some type of default like, Program Mode, so that if an unexpected photo opportunity presents itself, the camera can be quickly accessed and fired without having to reset previous settings.

There are a few settings on a digital camera that an investigator may use to their advantage. Even more valuable than the gratification of immediately reviewing photos offered by the digital camera is the ability to change one's ISO value from one image to the next. A photographer can use an ISO 100 film speed value when recording colorful bloodstains on a car's chrome rim, immediately switch to an ISO 400 setting to capture a flash exposure of the vehicle's back seat where bloody clothes were found, and switch again to ISO 800 or 1600 to document latent bloodstains treated with luminol. However, while the frequent changing of ISO settings can enhance one's overall documentation of a crime scene, the photographer must double-check the ISO values from time to time to ensure that they are recording the scene as intended. The photographer's ability to change one's ISO value so easily is an undervalued benefit offered by digital photography. The value of having the ability to specifically set one's ISO value will be demonstrated shortly.

White balance is another setting often forgotten about when capturing images with a digital camera. For example, to eliminate the yellow stain caused by high-pressure sodium or incandescent garage lamps, a photographer can set the white balance to incandescent lighting to capture a color-accurate image. However, failing to reset the camera to a daylight setting and then capturing images in natural sunlight or with electronic flash will create a very distracting blue staining on the recorded image. This staining cannot always be completely removed by computer enhancements and may not be discernible in the small review screen on the back of the camera. Therefore, the photographer must be aware of the white balance setting prior to beginning every new photographic assignment. Furthermore, if the garage has LED lighting or the investigator is using LED light stands for illumination purposes, they should be aware that some LED lights may cast a blue tint onto the photographs. Today's digital cameras generally have a custom white balance feature that allows the photographer to compensate for these unexpected hues from different light sources. Therefore, investigators assigned to a vehicle examination facility should record test photographs using just the facility's fixed lighting and evaluate how they appear in the recorded images.

Digital cameras are now the primary means of recording images in the forensic field, as well as in the civilian world as a whole. However, along with every technical advance in crime scene photography comes additional responsibilities or impediments. For example, digital cameras come with a number of custom functions that can be hidden deep inside a camera's menu system. For those unlucky crime scene photographers who must share their equipment with other investigators, it is even more important that all camera settings such as exposure compensation, film speed, white balance, auto exposure bracketing, and flash exposure compensation are set exactly as desired. Fortunately, these functions can easily be reset to factory defaults from the camera's menu. If one finds their camera's settings causing composition or exposure problems, every camera will have a reset to factory default setting somewhere in the menu system. This menu feature resets the camera to how it originally came from the factory. Once again, the value of completely reading the camera owner's manual and understanding how the camera works is paramount to preparing for actual scene work and obtaining quality crime scene photographs. Please read the camera's instruction manual completely and thoroughly.

Beyond the necessity of reading and comprehending the manual for each individual camera, an investigator must listen and feel how the camera is performing in order to realize when something is not working properly. For example, it should become routine for a photographer to check the exposure meter and the information displayed in the viewfinder while photographing, even when using an automatic exposure mode. Investigators should also listen to their cameras to ensure they are working properly. The most obvious audible information the camera provides to the photographer is when proper focus and exposure are achieved. Cameras typically provide an audible beep or some sort of visual clue inside the viewfinder when a proper exposure and/or focus is obtained. Investigators should be constantly aware of these alerts in order to record the best photographs possible. Most digital cameras have a small light on the back of the camera that lets the photographer know the camera is writing the recorded image to the storage media. The photographer should make a habit of checking that the camera is recording the captured images and every so often during the vehicle's processing. In fact, digital cameras should be set so that photography without an imaging chip is impossible. This feature is found in the menu system and will prevent wasted effort or worse, a complete loss of a vehicle's photographic documentation. Although it would be too time consuming to review every single image on a digital camera, photographers should periodically examine that photographs are being recorded as desired.

In addition to listening to and looking at one's camera, the photographer should feel for the camera's shutter activation. There is a rule of thumb that states one's shutter speed should be equal to or faster than one over the camera lens' focal length. This rule helps ensure that a stable image is recorded, removing any potential camera shake and thereby, improving a photographer's composition. For example, if a 28-mm focal length camera lens is used to capture an image and if the camera is handheld, then the minimum shutter speed should be 1/30th of a second. This rule does not apply if the photographer is using a tripod or other stabilizing device. Longer lenses require even faster minimum shutter speeds: a 200 mm telephoto lens should have a minimum shutter speed of 1/200th–1/250th of a second. The photographer should always round an exposure toward a faster shutter speed to be sure a sharp, non-blurry image is recorded. The faster shutter speed requirements may be difficult to maintain even during the daytime when the sun is blocked by clouds and lower ISO settings are chosen. It is important that photographers listen to and carefully feel the camera's operation in order to ensure they do not hear or feel the distinctive double-click of the shutter opening and closing. While hand holding the camera, the photographer should only feel one quick shutter actuation. If two distinct clicks (shutter opening and then closing) are felt, then the recorded photograph will likely develop camera shake or blur in the image. The shutter's action should feel and sound like just one instantaneous event. As stated, this is just a rule of thumb, and some individuals may be able to push the envelope a little, but very little, maybe by half a stop of light. Other photographers may find that they need to keep their shutter speed one or two full stops faster than this rule of thumb. Practice and experience will help identify a comfortable zone for the photographer to work in. For those who do not have a steady hand and who find themselves in need of faster shutter speeds to guarantee sharp images, there are a couple of solutions. A monopod support may be helpful to stabilize the camera (Figure 5.1). Another solution is to purchase a

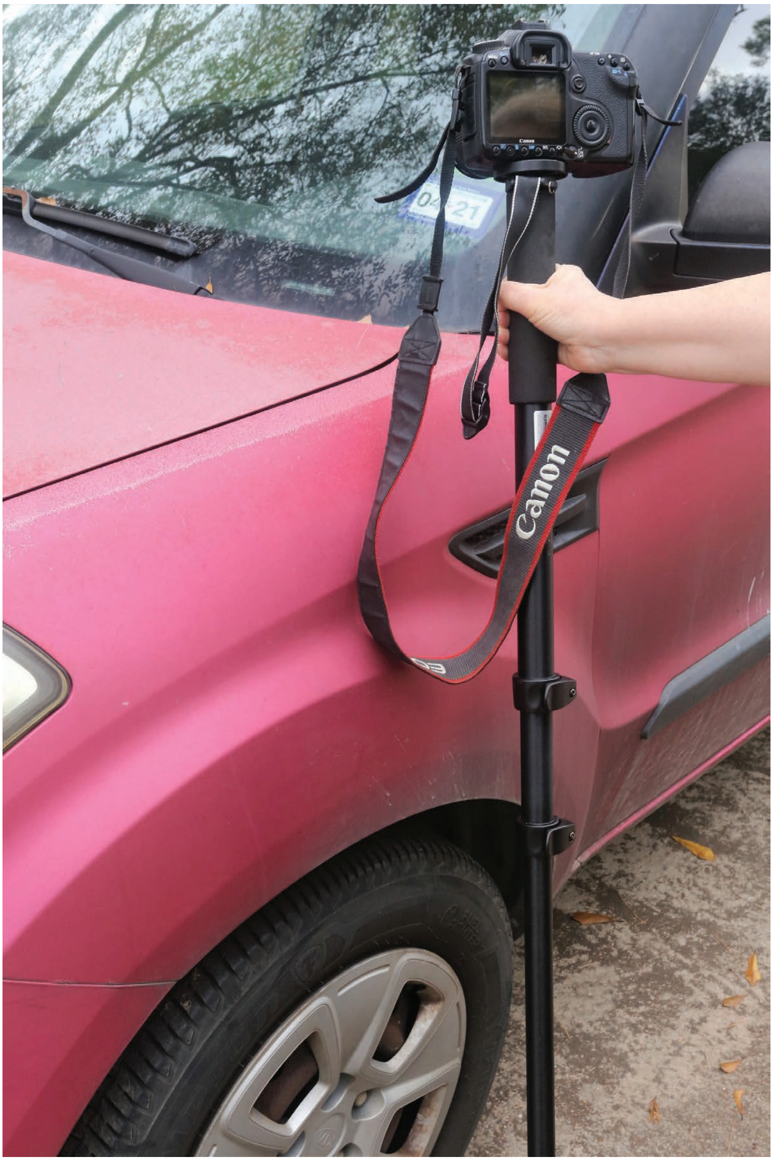


Figure 5.1 A photographer uses a monopod to ensure a stable camera and ultimately, a sharp focused image. Photographic images can develop blur or motion in them if the photographer fails to maintain a steady camera. Tripods will also ensure a motion-free or blur-free photograph, but a monopod is a little easier to maneuver around a vehicle with and can be just as valuable to ensure a crisp, sharp recorded image.

vibration reduction or image stabilization lens. These specialty lenses can compensate for minor camera movements or shake.

Another suggestion for better overall photographs is to critically examine one's work from previous photo assignments and/or training exercises. Critical evaluation of one's own work is recommended because it enables the photographer to see where their photography can be improved through lighting, composition, depth of field, etc. Also, this evaluation can also help identify problems with cameras and equipment and help prevent compromising future photographic endeavors. As camera gets older, shutter curtains, light meters, and the imaging sensor can all start to fail, all of which can impact the quality of a photograph. One important way in which investigators can prepare to be better crime scene photographers is to train and practice with their personal equipment. No one should just be handed a camera, told to set the camera to an automatic mode, and then be advised to go forth and conquer. In the past, this was a standard practice. However, in today's forensically knowledgeable world, processing a crime scene or photographing a motor vehicle involved in a criminal act requires a thoughtful and professional approach to all photographic examinations.

Practice and training are important first steps to becoming a great photographer. The investigator does not need a photography degree to be a crime scene photographer, but they should be comfortable and confident in operating their photography equipment in the manual exposure mode. It is not that every photograph must be taken in the manual mode, but when a challenging composition confronts the photographer, taking full control over the camera is an important skill to possess. Regarding training, the reading of the camera's instruction manual is an obvious and important first step. Second, the reading of textbooks on general photography and crime scene photography is quite advantageous. Last but not least, training courses on crime scene photography are extremely beneficial. Quality training courses not only are informative but they also provide the student with opportunities to practice different photographic techniques and to visualize in a concrete way the hypothetical models presented by the instructors.

The practicing, experimenting, and testing of photographic techniques should occur both in and out of the classroom. For example, anytime new equipment is purchased, it should be tested to be sure it works correctly and to determine how it affects the photographic image. This is especially true in low-light and alternate light photography. Because the intensity and the quality of the numerous light sources available are so different, the photographer needs to experiment and practice taking photographs in both situations prior to working on an actual vehicle. In addition, these variable light sources react differently in various environments, such as in the enclosed trunk area or the overall exterior of a vehicle. Therefore, testing and practicing with the equipment that will be used in these environments and conditions are strongly recommended. A little practice and the knowledge gained from experimentation with any equipment will help engender confidence and result in improved crime scene photographs.

Even with all the practice and training, experienced photographers will still take multiple photographs of the same composition in order to ensure one exceptional photograph is achieved. "Bracketing" is a crucial step in the complete documentation of a crime scene. Bracketing is defined as the taking of multiple exposures of the same composition, but with different camera settings, lighting conditions, or camera angles. Two pictures are always better than one, and ten pictures are better than two. Although digital cameras provide the instant gratification of knowing whether an image appears well illuminated and in focus, the small review screens cannot always provide the type of accuracy one demands in the final printed image. Bracketing occurs across a number of variables found in photography. Lighting is first and foremost. In fact, most digital cameras have an "autobracketing" feature that makes it easier to photograph a subject at different exposure levels. However, this only scratches the surface of image bracketing.

Bracketing helps ensure that the best possible image is captured. When presented in court, bracketed photographs not only help the jury understand the dynamics of the crime scene but also help them see and appreciate the professionalism and dedication of the crime scene investigator's work. Because very few subjects outside of the laboratory are perfectly illuminated by studio lighting, bracketing is an absolute necessity in order to find the right balance between shadows and highlights. Automatic modes try to find a balance, but it is only what the camera believes to be a proper exposure. The camera is not perfect and can make exposure evaluation errors. Capturing one image in the automatic mode or with the camera's meter set to zero (18% gray) is a great place to start. 18% gray is the average reflectivity of nature and is what the camera seeks to find as a proper exposure evaluation. For the majority of time, the camera does this extraordinarily well. However, dark black, bright white, or highly reflective surfaces can cause difficulties to the camera's metering ability. There are quite a number of white, black, and glossy-painted vehicles on the road today and photographers need to be aware of the challenge they can offer. When facing a challenging composition, photographers should record, at the very least, two additional photographs of the same subject; one picture should add light to the image and one should subtract light. The amount of light added or subtracted is up to the photographer and largely depends on the subject. On bright, sunny days where the sun is reflecting brightly off a vehicle, a two-stop correction may be necessary to ensure that both the highlights and shadows are accurately recorded. On the other hand, cloudy days have much less contrast and may not require such drastic compensation. A one-stop change in exposure may be all that is needed. The bracketing for lighting may not always involve ambient light. Bracketed images can include the addition of fill flash or some type of painting-with-light technique to improve the image. Bracketing exposures will help ensure a quality captured image and final product that can be introduced at court with pride. It bears repeating that one should not always rely on the camera's light meter or the image review screen to guarantee that a quality photograph was recorded.

The media on which the image is recorded is another factor that affects how much bracketing is required. Color print film has an exposure latitude of approximately two stops of light. Black-and-white film can have an exposure latitude as much as three stops of light. Exposure latitude is defined as the amount of light the recording media can be overexposed or underexposed, but still achieve an acceptable resulting image. Ultimately, this means that a photographer can underexpose or overexpose an image by as much as two stops and still obtain a quality image. Therefore, bracketing film exposures by two full stops in either direction of what the camera shows as 18% gray is an excellent way to ensure that the absolute best photograph is recorded. However, digital cameras recording in the JPG format do not have as much latitude as print film. Metering exposures with digital cameras is more like photographing with slide film, in that the latitude for exposure errors is typically between one-half to one full stop of light. Therefore, bracketing with a digital camera may actually require that more photographs be taken of an important subject than what might be required if film was the recording media. For example, when photographing a subject with a great deal of contrast with a digital camera, a series of five images might be necessary. The first image would be the 18% gray or zero-balanced exposure as suggested by the camera, but then a pair of exposures with plus and minus one stop and plus and minus two stops of light should be recorded to ensure a complete range of exposures is recorded. Not until the images are printed or viewed full size can the best image be selected. Granted, image enhancement programs such as Adobe Photoshop® can correct minor errors in exposure, but the goal of the crime scene photographer should be to record quality images at the time of capture and not rely on post-capture editing programs to create the final image.

Bracketing compositions for exposure is only the beginning, especially for those important or key photographs in a crime scene photographer's investigation. Photographers should not be shy about recording images from different camera angles to show evidence in its best light, both literally and figuratively. Regarding lighting, photographers may consider recording images, especially those found inside a vehicle, with different light sources, such as ambient light, electronic flash, or static light sources that might be available. Other bracketing techniques might include changing one's focus point or changing the aperture to adjust the image's depth of field. It is critical that the image's subject be in focus, and bracketing helps ensure a quality result. As will be discussed later in this chapter, control over an image's depth of field separates a snapshot from an exceptional crime scene photograph. To ensure everything in a photographer's viewfinder is in focus, he or she can record a series of images with the zone of focus or depth of field adjusted through the depth of the composition in a series of recorded images. By completing this series of photographs, the investigator guarantees that the entire scene or subject is in focus in at least one of the images. This will ensure a complete and accurate recording of the crime scene and have the added benefit of helping the image viewers observe how the pieces of evidence relate to one another. Bracketing might also include the photographer's point of view. Evidentiary photographs can be recorded from different angles, different heights, or from different perspectives, like from the victim's point of view or the suspect's point of view. Adjusting perspective is another way in which to bracket exposures. Changing the physical location of the camera, whether by climbing up on the garage's step ladder or lying on the ground while taking a picture underneath a vehicle, will also enhance the overall documentation of a crime scene or vehicle. In the end, important subjects should be photographed at different angles in order to show the different relationships between the item and its environment.

Basic Exposure Evaluations: ISO, Aperture, and Shutter Speed

To begin with, all cameras evaluate light, and light is broken down into "stops" or fractions of a stop. A full stop of light is equal to one-half or twice as much light as the next full stop. Therefore, if one increases an exposure by one stop, then effectively twice as much light is allowed to enter the camera and affect the composition. If one decreases an exposure by one stop, then one-half the amount of light is subtracted from the composition. The idea or concept of a stop allows one to compare apples to oranges. In regard to the camera, the apples and oranges refer to the camera's settings for ISO values, apertures, and shutter speeds (the exposure triangle). By breaking light down into stops, the photographer is able to compare equal amounts or values of light among the ISO values, apertures, and shutter speeds. Eventually, these values can be adjusted in order to fine-tune an exposure or make reciprocal changes in an exposure's calculation. As an example of reciprocity, if an accurate exposure can be made with the camera set to ISO 100, f/8 (aperture or lens size), for 1/250th of a second (shutter speed) and one desires to increase the depth of field by decreasing the aperture's size to f/16, then a reciprocal change(s) in the other values must be made to balance the loss of two stops of light (f/8 to f/11 to f/16). Possible adjustments in the exposure could include the following:

- ISO 100 (constant), f/16 (–2 stops), at 1/60th of a second (+2 stops)
- ISO 400 (+2 stops), f/16 (–2 stops), at 1/250th of a second (constant)
- ISO 200 (+1 stop), f/16 (–2 stops), at 1/125th of a second (+1 stop)

A photographer needs to have a basic understanding of exposure to be a successful crime scene photographer. The basic principle of light and stops of light should already be understood by the reader before progressing any further into this book. A multitude of books explain light evaluation, but anyone with a camera should already own such an explanatory text—it is the camera's instruction or owner's manual. The instruction manual does offer most readers a basic understanding of how one's camera evaluates an exposure and how their particular camera model breaks down stops of light. Commonly, cameras are able to break down light evaluations into half-stops or third-stops. As a refresher, full stops of light are typically identified as follows, although this list is far from all inclusive:

- ISO values
- 100—200—400—800—1600—3200—6400—12,800
- Apertures
- f/1.4—f/2.0—f/2.8—f/4.0—f/5.6—f/8.0—f/11—f/16—f/22—32
- Shutter speeds
- 1/1000—1/500—1/250—1/125—1/60—1/30—1/15—1/8—¼—½—1 second

Basic light evaluation and camera operation are all based on combining the values of ISO, aperture, and shutter speed. Because everything in photography is about give and take, photographers must decide which exposure variable is most important for each composition and which exposure value can be sacrificed. The ISO value sets the camera's sensitivity to light, and the lower ISO values offer the best color and image sharpness (Figure 5.2). The choice of aperture is primarily about the depth of field. Larger apertures limit the image's zone of sharp focus, while smaller apertures extend the depth of field (Figure 5.3). The final variable is shutter speed, and shutter speed controls the motion. The motion can come from subject movement, as well as photographer's movement. Crime scene photographers should be comfortable with long exposures, just as much as they are with quick exposures (Figure 5.4). Quality photography begins with taking control of the photographic process, which will most likely require the camera to be moved off of the "Program Mode." By moving to the manual mode or one of the priority modes, the photographer can choose the exposure value or values most important to them and record better overall compositions.

The ISO value is determined by the choice of the film inserted into the camera or by the digital camera's particular ISO value selected. The choice of an ISO value will set the camera's sensitivity to light and will be the baseline from which the aperture and shutter speed choices will combine to create an exposure. The range in aperture choices is determined by the particular lens attached to the camera. Therefore, not every photographer will have the same flexibility in exposure evaluations because of the variety of lenses and their capabilities. If one is using a point-and-shoot style of camera, then the aperture range is likely to possess a very narrow gamut of available apertures. The range of available

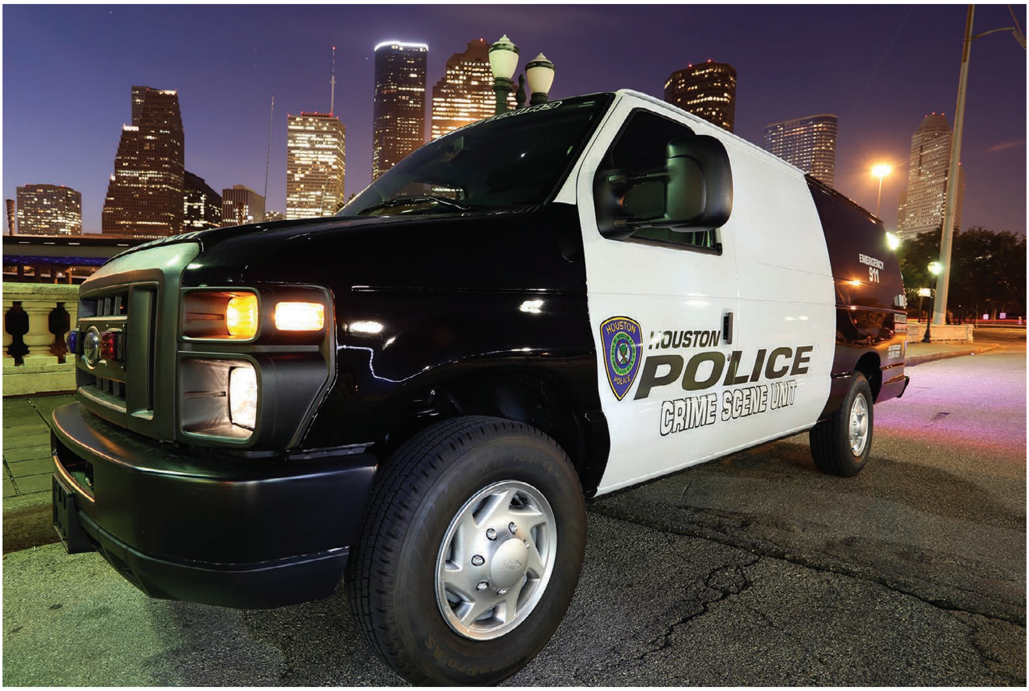


Figure 5.2 Lower ISO values provide the sharpest images, with the best color. The ISO value of 100 is often recommended for any evidentiary photograph that is used for comparison and analysis. This composition was recorded at ISO 100, f/8, for 30 seconds.

shutter speeds typically offers the greatest flexibility or greatest range of available values and will be determined by the camera's capabilities. SLR cameras typically have a range of shutter speeds from 30 seconds to 1/4000th of a second. Point-and-shoot cameras may or may not have as much versatility. Crime scene photographers are much more likely to employ slower shutter speeds, especially when working in low-light conditions. Therefore, the faster shutter speed values are not used frequently by crime scene photographers. Photographers should also possess a camera capable of B (Bulb) or T (Time) exposures that allows the camera's operator to keep the lens open as long as the photographer desires. Evidence technicians could benefit from reviewing exposure calculations and other photography topics discussed in this author's book, *Advanced Crime Scene Photography*.

It does not require a Ph.D. ("Push Here Detective") to operate a camera. Crime scene photography may not be as easy as aim and shoot, but certainly it is not rocket science. Fortunately, cameras provide the photographer with a plethora of information, and the user simply has to become accustomed to what the camera is seeing and what the camera is saying about a composition. The majority of electronic SLR cameras can be operated in a number of different modes capable of adapting to a photographer's particular style. The basic operating modes of modern SLR cameras are as follows:

- *Program mode*—Camera selects aperture and shutter speeds
- *Shutter priority*—User selects shutter speed and the camera selects aperture
- *Aperture priority*—User selects aperture and camera selects shutter speed
- *Manual*—User selects aperture and shutter speed

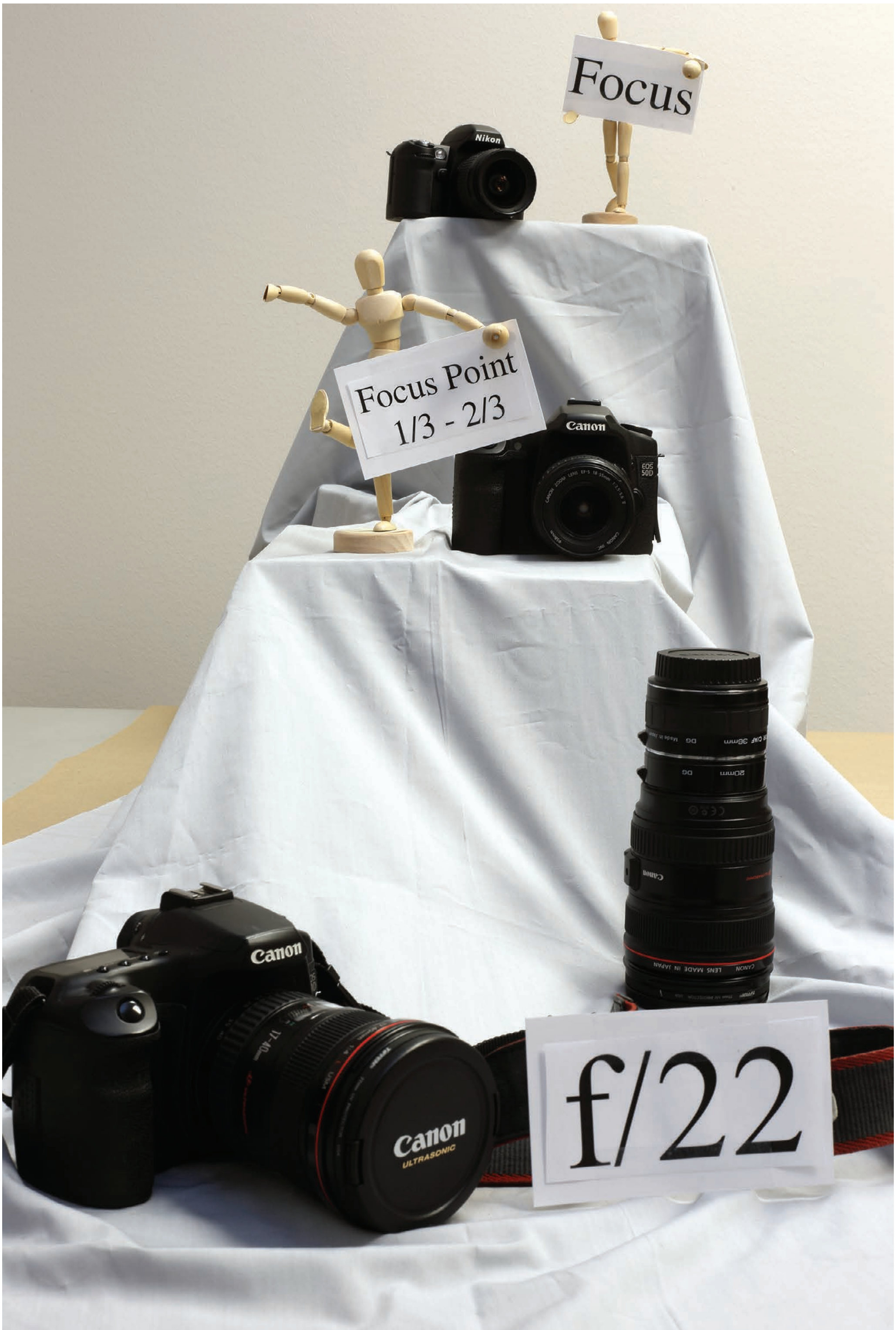
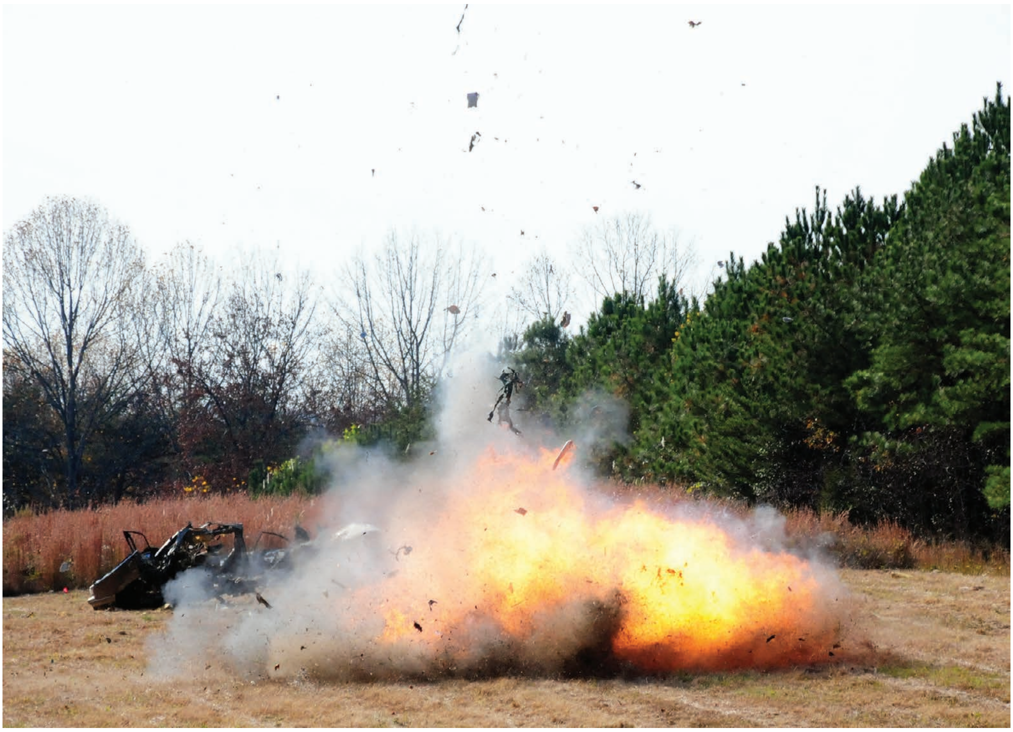

Focus
Focus Point
1/3 - 2/3
f/22

Figure 5.3 The zone of sharp focus extends throughout this entire composition and was recorded at ISO 100, f/22, for 4 seconds.

(a)



(b)

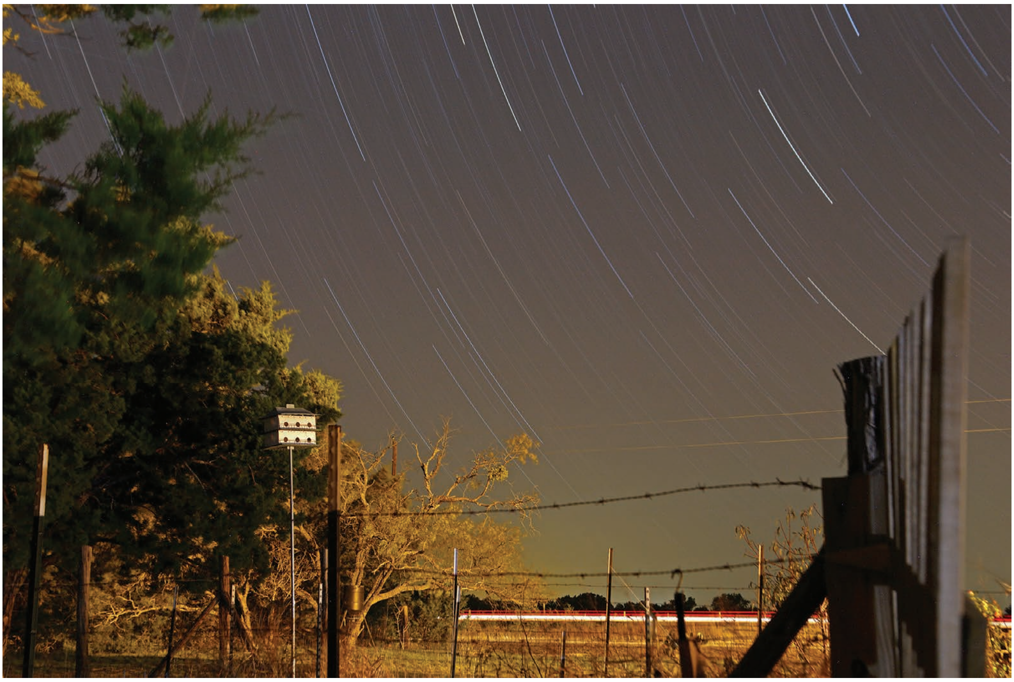


Figure 5.4 Shutter speeds can be just a fraction of a second to several minutes long. (a) The image was recorded at 1/2500th of a second and was able to stop the explosive action of a bomb. (Photograph by Ernest Aguilera, Crime Scene Investigator. With permission.) (b) The image was recorded over the course of 45 minutes and recorded the movement of stars across the nighttime sky.

Photographers are also likely to find custom modes and "creative modes," as well as the basic exposure modes, on their camera's command dials. However, for crime scene photographers, these modes are less likely to be used. Becoming familiar with the camera's functions and how to read the information contained within the viewfinder are vitally important toward understanding what is occurring within the camera and to the composition itself.

Comprehending the information contained within the camera's viewfinder or displayed on its liquid crystal display (LCD) screen is vitally important for photographers. Failure to recognize when the camera is having difficulties with a particular exposure is likely to produce poor photographs. The camera's instruction manual is a photographer's best resource for information on their camera. However, technical manuals and books are published about the specific use of higher-end SLR model cameras, and these materials can help photographers utilize their cameras to the maximum potential. In many police departments, cameras are issued to investigators and the manuals have been long-since lost. Fortunately, many camera operation manuals can be found on the individual manufacturer's website and downloaded for free.

In the end, obtaining a proper exposure is not a difficult proposition. All crime scene photographers have to do is know how their cameras work and what the cameras are telling them about their compositions in the viewfinder. Exposures are easily calculated by the camera, and they can even make reciprocal changes to the ISO, aperture, and shutter speed values when necessary. However, there will be times when photographers must recognize conditions that can fool their cameras' light meters. For example, any photographer who attempts to photograph a backlit composition or gunpowder residue on black clothing will need to understand what the camera is using to calculate an exposure. A camera's light meter is searching for an 18% gray evaluation of light, which means that bright-white or jet-black subjects can cause severe underexposure and overexposure in photographs. Operating in a manual mode allows for changes to be made to exposures that are outside the camera's ability to accurately meter in an automatic mode. Photographers must be capable of compensating for such evaluation problems caused by difficult compositions. Understanding how the camera operates and how it meters light will only improve a photographer's body of work.

Depth of Field or Zone of Sharp Focus

The depth of field is a basic concept that should be understood by all crime scene investigators. As a review, the depth of field is defined as the area of sharp focus surrounding a subject (Figure 5.5). This area or zone of sharp focus extends approximately one-third in front of the point of focus and two-thirds to the rear. This becomes important when photographing a series of subjects over an extended distance, such as a series of bullet holes along the length of a pick-up truck. Three key factors affect a photographer's depth of field or zone of sharp focus:

- Aperture
- Focal length of the lens
- Subject-to-camera distance

(a)

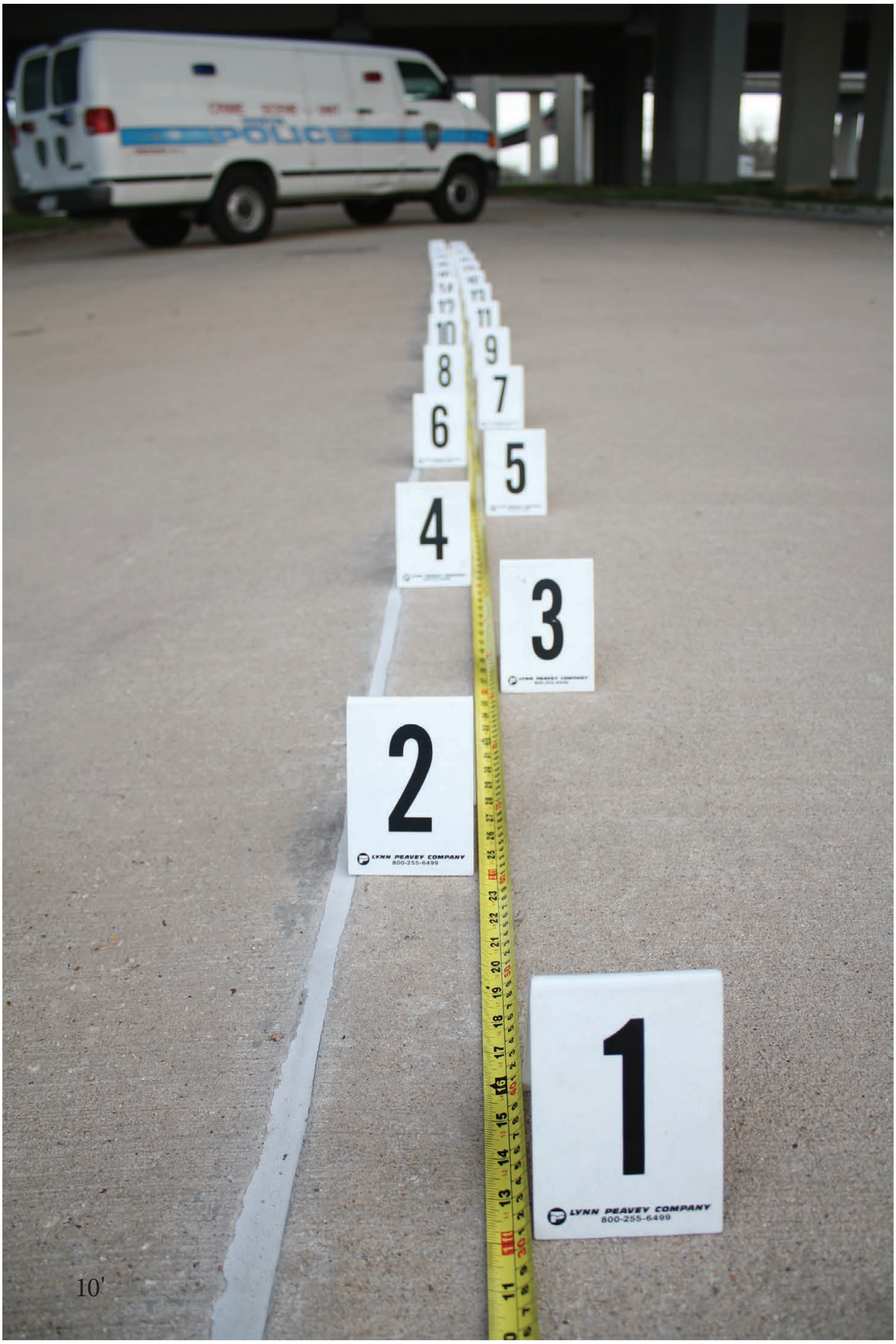


Figure 5.5 Depth of field is defined as the zone of sharp focus. Depth of field is affected by aperture, focal length, and the distance between the subject and camera. In (a) and (b), evidence markers were placed in 1' increments from the camera and recorded with a 28 mm focal length lens. The focus for these images was on evidence marker #1. (a) This image was recorded with an aperture of f/3.5 and (b) with an aperture of f/22. Observe the difference in the sharpness of the evidence markers as they get farther and farther away from the point of focus.

(b)

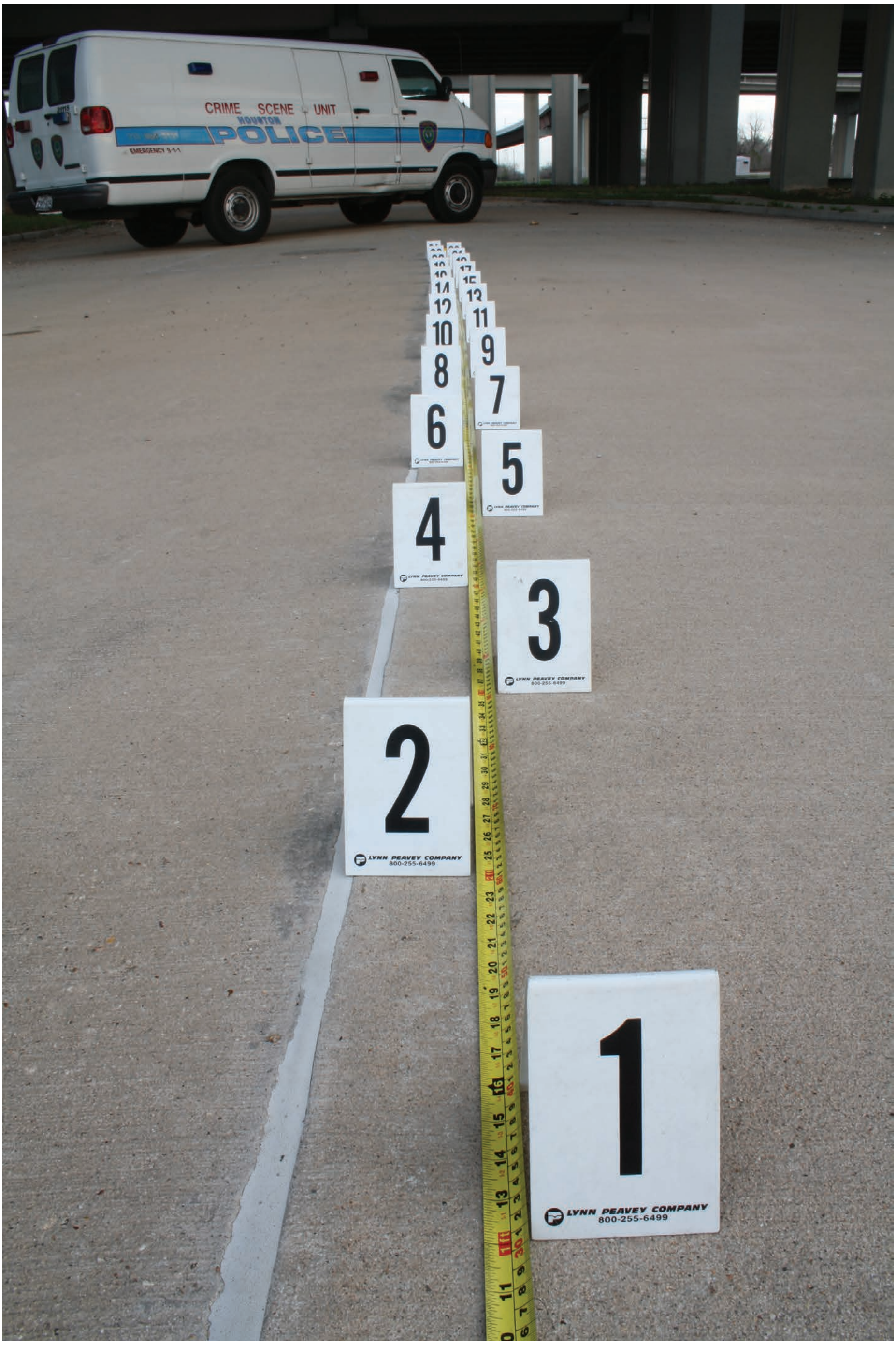


Figure 5.5 (Continued) Depth of field is defined as the zone of sharp focus. Depth of field is affected by aperture, focal length, and the distance between the subject and camera. In (a) and (b), evidence markers were placed in 1' increments from the camera and recorded with a 28 mm focal length lens. The focus for these images was on evidence marker #1. (a) This image was recorded with an aperture of f/3.5 and (b) with an aperture of f/22. Observe the difference in the sharpness of the evidence markers as they get farther and farther away from the point of focus.

(c)

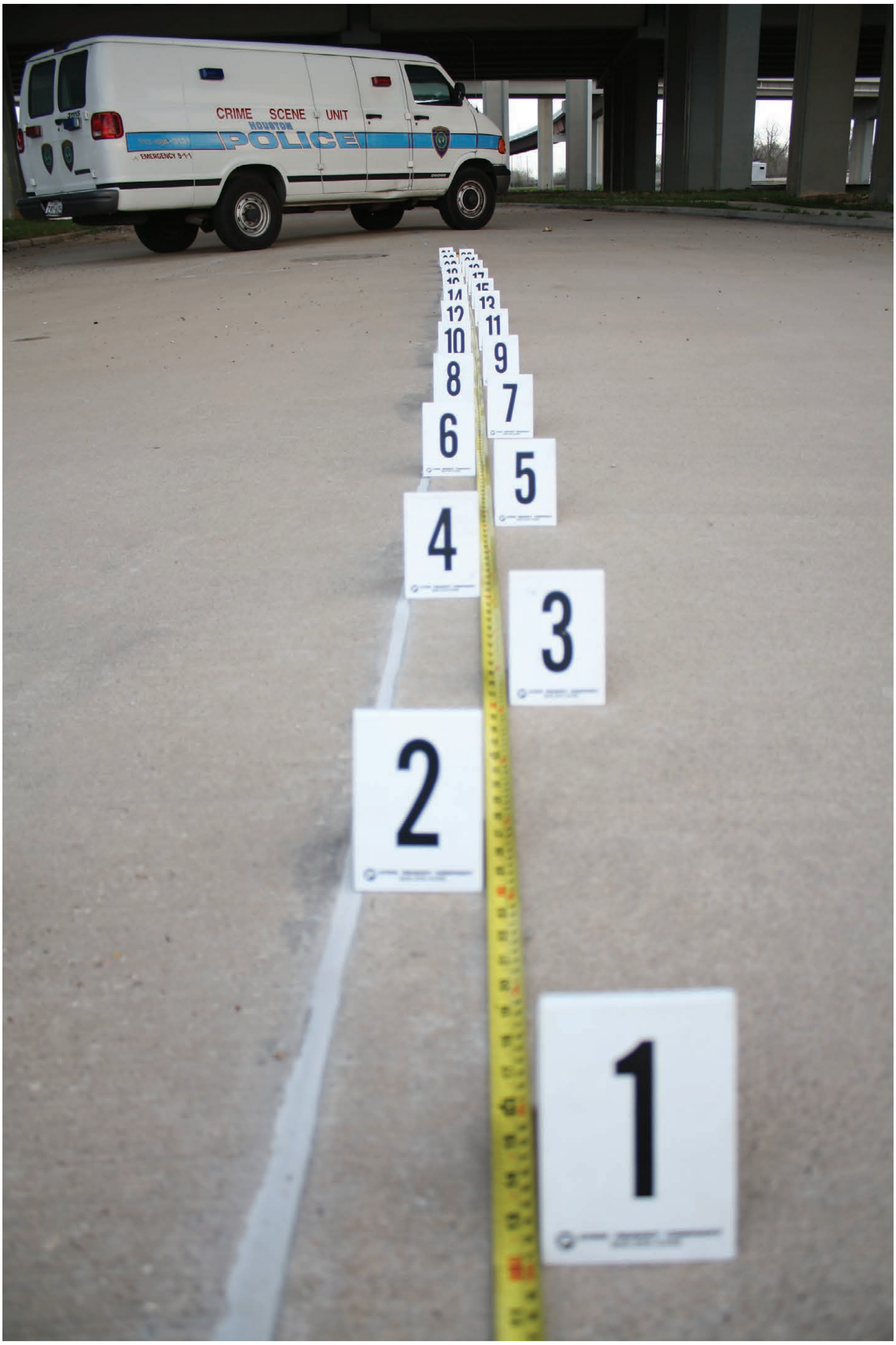


Figure 5.5 (Continued) (c) and (d) These images were recorded in the same manner as (a) and (b), but the point of focus was moved 10' away from the camera and placed on evidence marker #10. (c) This image was recorded with an aperture of f/3.5. (d) This image was recorded with an aperture of f/22. Notice how the depth of field extended much more to the rear for both images, but the image recorded with the large f/3.5 aperture. (c) This image suffered much more toward the front. Longer focal lengths and subjects physically closer to the camera lens will significantly decrease the zone of sharp focus.

(d)

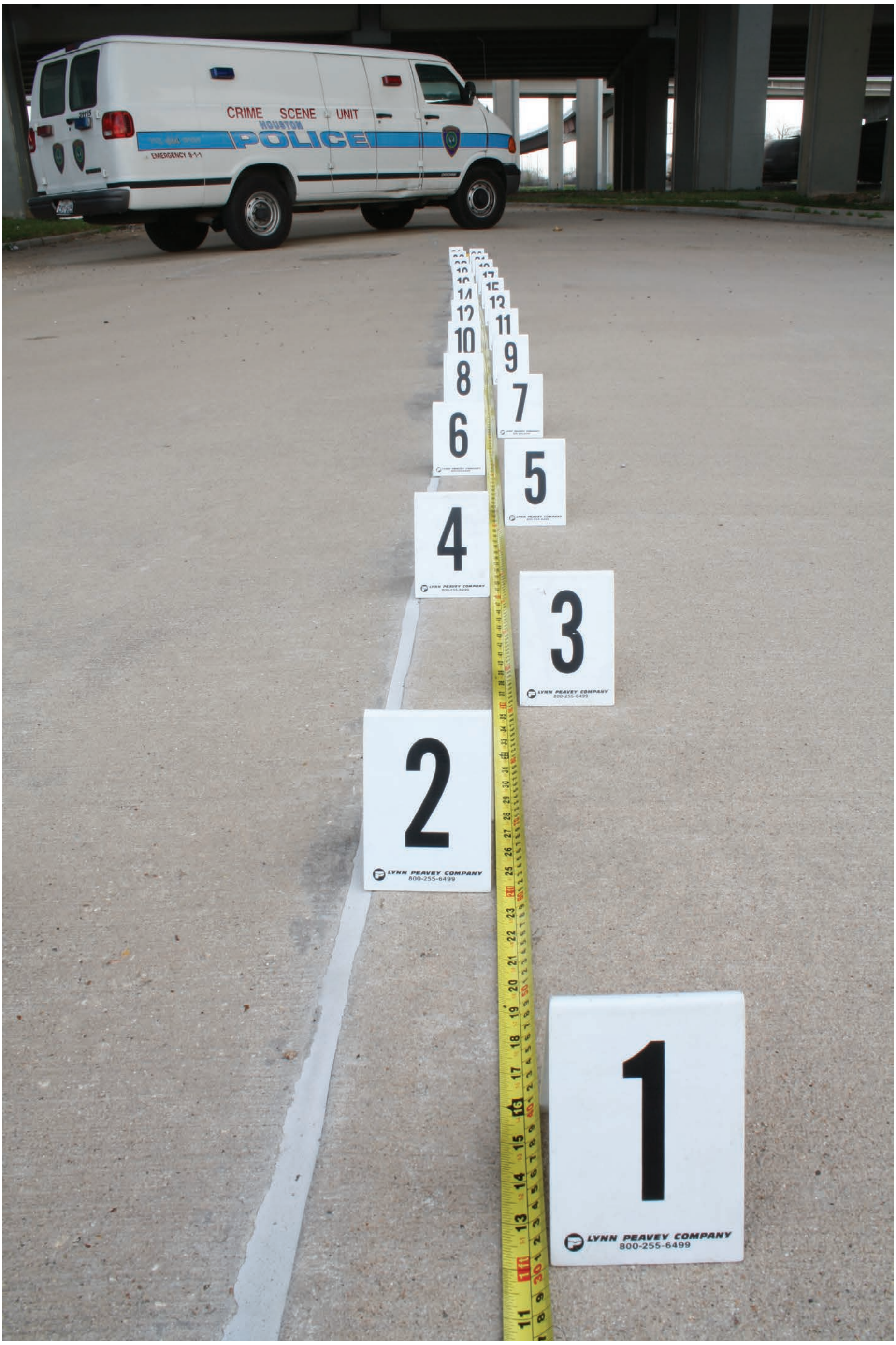


Figure 5.5 (Continued) (c) and (d) These images were recorded in the same manner as (a) and (b), but the point of focus was moved 10' away from the camera and placed on evidence marker #10. (c) This image was recorded with an aperture of f/3.5. (d) This image was recorded with an aperture of f/22. Notice how the depth of field extended much more to the rear for both images, but the image recorded with the large f/3.5 aperture. (c) This image suffered much more toward the front. Longer focal lengths and subjects physically closer to the camera lens will significantly decrease the zone of sharp focus.

(e)

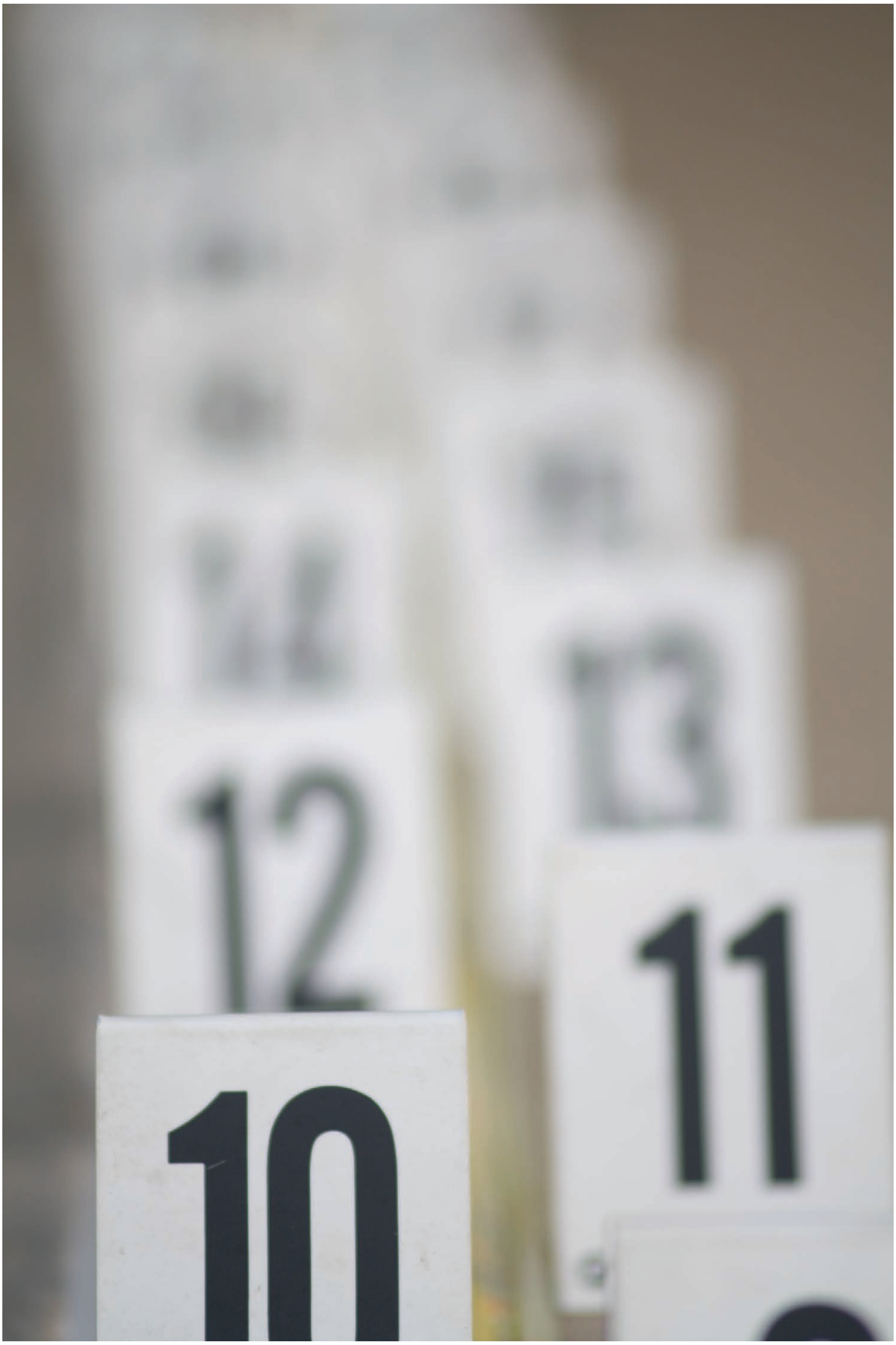


Figure 5.5 (Continued) (e) and (f) These images were both recorded with an aperture of f/2.8 and with a 325 mm focal length lens. The image (e) focused on evidence placard #10, while the image (f) focused on placard #15. Observe how the zone of sharp focus is slightly better in the image focused 5' farther away from the camera's lens, but the depth of field in both images is still significantly reduced because of the longer focal length used to capture the images.

(f)

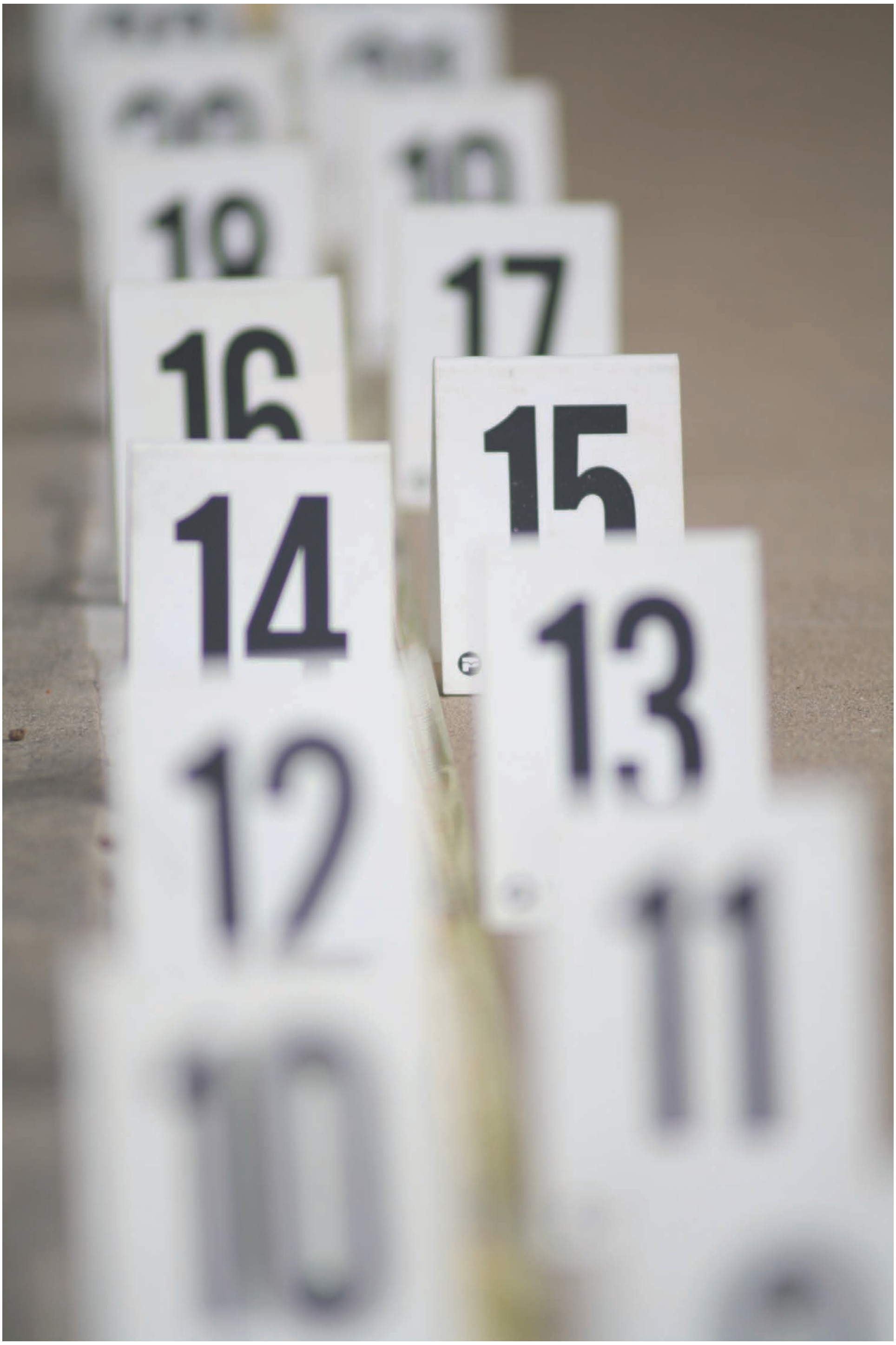


Figure 5.5 (Continued) (e) and (f) These images were both recorded with an aperture of f/2.8 and with a 325 mm focal length lens. The image (e) focused on evidence placard #10, while the image (f) focused on placard #15. Observe how the zone of sharp focus is slightly better in the image focused 5' farther away from the camera's lens, but the depth of field in both images is still significantly reduced because of the longer focal length used to capture the images.

Aperture is the most straightforward factor affecting the depth of field. The smaller the aperture, the greater the depth of field. The larger the aperture, the more shallow the depth of field. A deeper zone of sharp focus occurs with smaller apertures because the rays of light are more finely focused on the recording media as they pass through the narrower opening of the camera's lens. Remember that smaller apertures have larger f/stop (aperture) value numbers and vice versa. Be aware that the smaller openings do not allow in a great deal of light, and therefore, the exposure must be compensated with slower shutter speeds or greater ISO values.

Everything in photography is about give and take. Aperture selection is important in depth of field considerations and the exposure compensation necessary for a change in aperture is completed through changes in shutter speed or ISO value. Shutter speed times and ISO values do not have any effect on an image's focus, just the overall image's exposure or lighting. The depth of field can also be affected by the lens' focal length and by the subject-to-camera distance. These two values are related to each other, and both factors have a "ying and yang" type of effect on the depth of field. For example, if a photographer uses a wide-angle lens (28 mm) in order to increase the composition's depth of field, then the photographer may have to get closer to their subject in order to create the composition. Moving in closer to the subject will decrease a composition's depth of field, effectively cancelling out the benefit of using a wide-angle lens. Again, the trade-off with apertures is the time of the exposure (shutter speed value) or the quality of the exposure (ISO value), neither of which affects the depth of field and therefore is a very important feature of the camera to comprehend and use to one's greatest benefit. One word of warning about choosing very small apertures and that is that they do provide the best depth of field, but they can require longer exposure times, which may necessitate securing the camera to a tripod or other stable platform. This rule is and will be repeated because it is that important to remember.

The focal length of a lens will also affect an image's depth of field. With all else equal, longer focal lengths decrease a picture's zone of sharp focus, while wide-angle lenses increase it. One effective way to create an indistinguishable background is by creating a shallow one of sharp focus with telephoto lenses. Because of their longer focal lengths, 200 and 300 mm lenses can effectively blur and eliminate a subject's background. Limiting the depth of field and the visibility of any background helps draw the viewer's eyes directly to the subject of the photograph. This may be desirable when the background is distracting, such as when other investigators are milling around behind a vehicle being processed. At times, investigators may use the zoom feature in order to enlarge a subject in the viewfinder instead of physically moving closer to the object. Isolating the subject and bringing it to dominate the image are made easier by controlling one's depth of field and by making it shallow, which allows the subject to stand out more prominently (Figure 5.6).

On the opposite end of the focus spectrum, every camera lens reaches a point where the depth of field ceases to be an issue. Almost every lens has an infinity (∞) mark on its focusing ring. At this point or distance from the camera's lens and beyond, all subjects will be in sharp focus. This is not to say the foreground will be in the zone of sharp focus, but everything beyond the point of infinity and just before it will be in focus. Many camera lenses have a distance scale printed on the focus ring that tells the photographer at what distance infinity is reached. If the infinity distance is not present on the lens, the information should be found in the owner's manual for that particular lens. Being aware of how distance affects one's depth of field and knowing how to compensate with proper aperture and focal length choices make the difference between a simple snapshot and a valuable crime scene photograph.

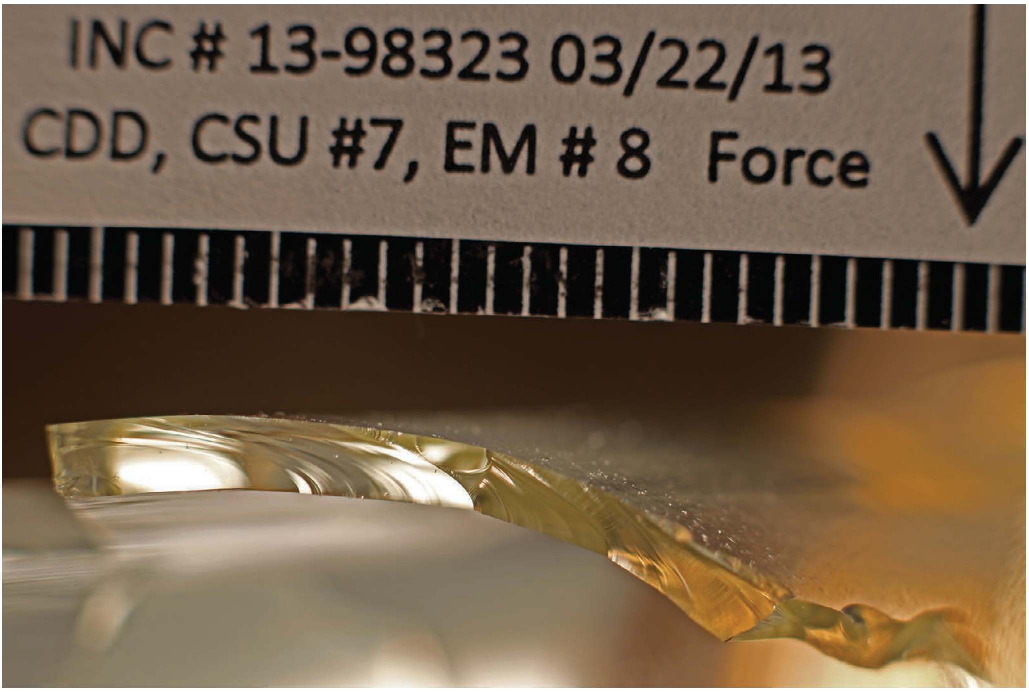


Figure 5.6 This figure is of the stress markings (Wallner lines) on the edge of a fractured piece of glass. The image was recorded with an aperture of f/4.0 in order to isolate the visibility of the fracture lines. An aperture of f/22 allows for a deeper depth of field but obscures the visibility of the fracture lines because the focus extends through the glass and not just the Wallner lines on the top edge of the glass.

Finding the right combination between camera-to-subject distance, focal length, and aperture is the artistic part of crime scene photography. Of course, the "point" where a photographer focuses will be in focus, but what else is in focus is controlled by them as well. Anyone can take snapshots of a cartridge case, but it is the artist who is best able to include the legible image of the cartridge's head stamp and still have its relationship to where it was found in the vehicle clearly visible in the image. Out-of-focus images do not impress anyone, especially the jury, and it does not matter what caused the blurry nature of the photograph. The jury will judge the investigator by the careless, out-of-focus photographs they are shown. The investigator can explain in court about depth of field and why something is not focused as sharply as it should be, but excuses should not be the lasting impression left with a jury. A sharp-focused image is of primary importance to the crime scene investigator, and control over a photograph's depth of field will go a long way toward improving the focus and overall quality of the final image (Figure 5.7).

Overall, Mid-Range, and Close-Up Photographs

Many crime scene investigators have heard the mantra surrounding how a crime scene should be photographed from the outside in. This usually takes the standard three-step form of recording the overall perspective images, to the mid-range or relationship

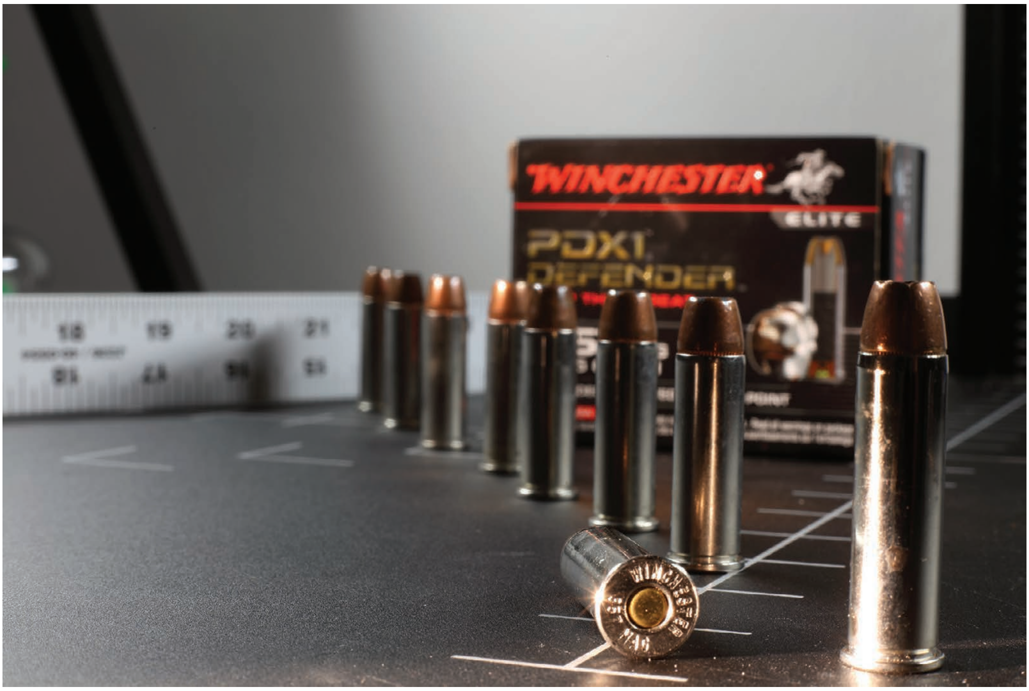


Figure 5.7 The cartridge's head stamp is observed in the foreground as well as the ammunition box in the background. The photograph's depth of field was limited because it was photographed through a 50 mm lens, with a 12 mm extension tube attached to the lens. Only a couple of inches separated the lens from the cartridge. An aperture of f/22 was chosen in order to extend the zone of sharp focus as far as possible.

photographs, and finally to the more detailed close-up pictures of individual items of evidence. This same philosophy is found in the processing of motor vehicles as well. The overall condition of the vehicle should be documented from various viewpoints. The mid-range photographs should be taken to illustrate the relationship of evidence to where it was found on or inside the vehicle. And finally, the close-up photographs should show the important details of individual pieces of evidence. In the end, the goal is to record in full detail what the vehicle looked like, what and where evidence was found, and with as much detail, tell the story the car has to say about the crime being investigated.

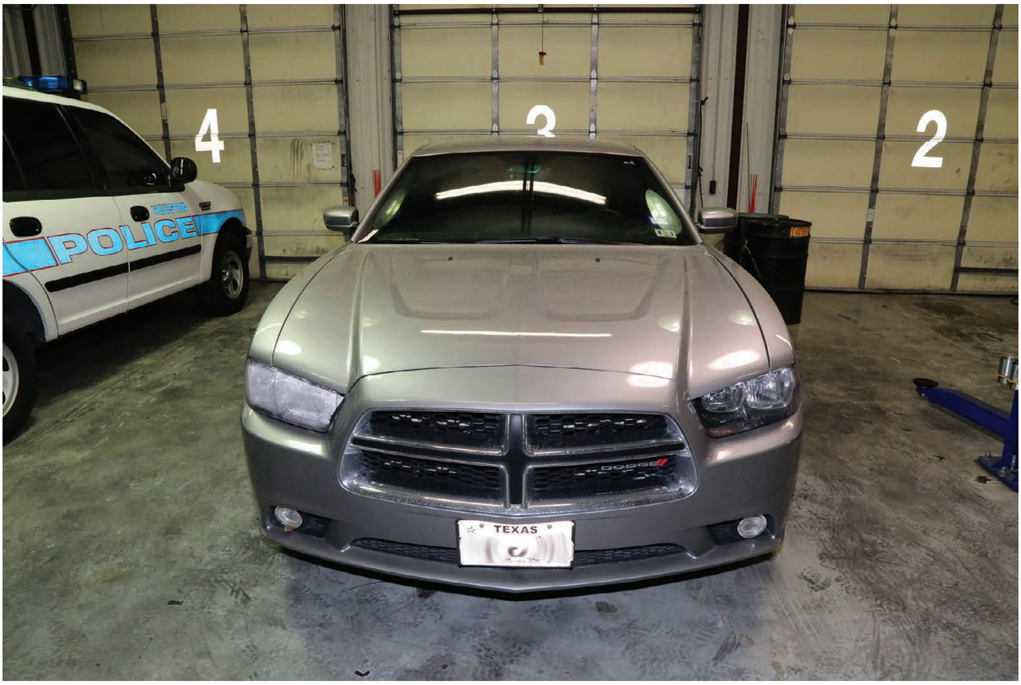
Before attempting to close focus on individual pieces of evidence, the entire vehicle should be fully documented with photographs. This may seem an unnecessary or a redundant statement, but far too often investigators zero in on the evidence found at a crime scene or on a vehicle and fail to document its relationship with the overall scene or other pieces of evidence. Overall scene photography is often overlooked and undervalued as a step in the vehicle's documentation process. The photographer must always remember that the juror was not at the crime scene and needs to be shown the layout of the entire site or in this case, the condition of the entire vehicle. Therefore, photographic documentation of the vehicle must be complete and thorough. Beyond telling a story via photographs, the investigator needs to document the condition of the vehicle, whether it was damaged. It is not uncommon for owners to make false claims, related to the crime or about damage that was never present on the vehicle. Therefore, the entire vehicle must be photographed in detail, regardless of whether it was damaged and/or affected by the crime.

Processing vehicles in a consistent and organized pattern will help prevent the accidental omission of valuable pieces of photographic evidence. Photographing the vehicle from a general, overall viewpoint to the more specific details found on individual pieces of evidence is logical and recommended. A crime scene's overall or long-range photographs are meant to establish the location or vehicle in a concrete manner for the viewers. When photographing the vehicle's exterior, the investigator should not be shy about the number of photographs taken. The vehicle is just a miniature crime scene on wheels. Although vehicles may require more detailed photographs here and there, a good start in documenting the exterior would include the following series of images (Figure 5.8):

- Entire front end
  - View looking down at the hood and front grill or bumper
  - View looking straight at the front grill or bumper, including the windshield
- Entire rear end
  - View looking down at the trunk and rear bumper
  - View looking straight at the rear bumper, including the rear window
- Full driver's side
  - View of the back-left quarter panel
  - View of the driver side doors
  - View of the front-left quarter panel
- Full passenger's side
  - View of the back-right quarter panel
  - View of the passenger side doors
  - View of the front-right quarter panel
- Overall view from above using the step ladder and this can also be from multiple perspectives or angles

As a way of establishing the car's identity, if the vehicle has a license plate, it should be clearly seen in a couple of these photographs. By completing a 360° view of the vehicle, one is able to obtain a common reference point between each pair of sequential photos from which to connect all the images together. This is equivalent to working a crime scene and photographing the scene with some sort of identifier, like a street sign or a business' marquee in the photograph. When photographing a vehicle, the crime scene investigator must remember that they are trying to connect any evidence found inside the car back to this original overall photograph depicting the car and the license plate. Everything must be connected in photographic form in order to tell a complete story to the viewer. Granted, some vehicles will not have license plates, but there will be something unique about the vehicle that can be used as an identifying reference point. Of course, the vehicle identification number (VIN) will be photographed at some point, but it is not likely that an overall photograph of the vehicle can be recorded and at the same time have the ability to read a VIN plate under the front windshield. These overall vehicle photographs may be recorded more than once during the vehicle's processing. One set of images should be recorded as "in situ" or "as is" photographs and then while the vehicle is being processed, additional overall photographs can be recorded. For example, in the case of a shooting, one overall in situ image of the full driver's side is recorded and then another full driver's side is recorded

(a)



(b)

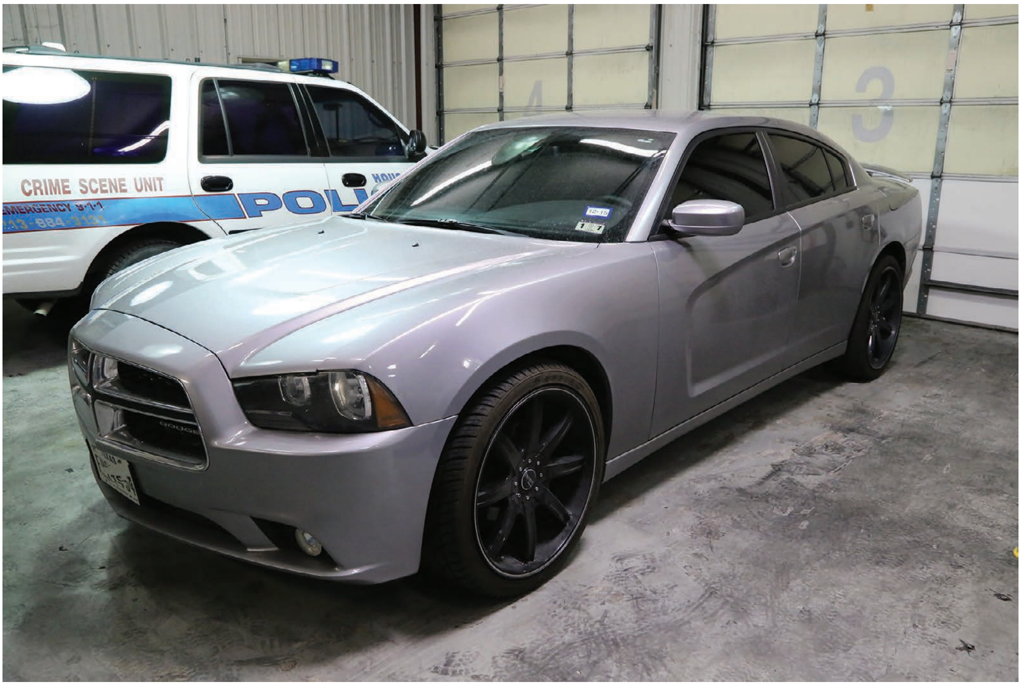


Figure 5.8 Here are a selection of "overall" photographs of a vehicle being processed. These were not the only overall photographs recorded, but a selection that might be consistent with those chosen to show a jury. (a) Overall photographs need to establish the vehicle's identity and that is typically done by recording a sharp-focused image of the vehicle with its license plate clearly visible. (b) Overall photograph of the driver's side of the vehicle.

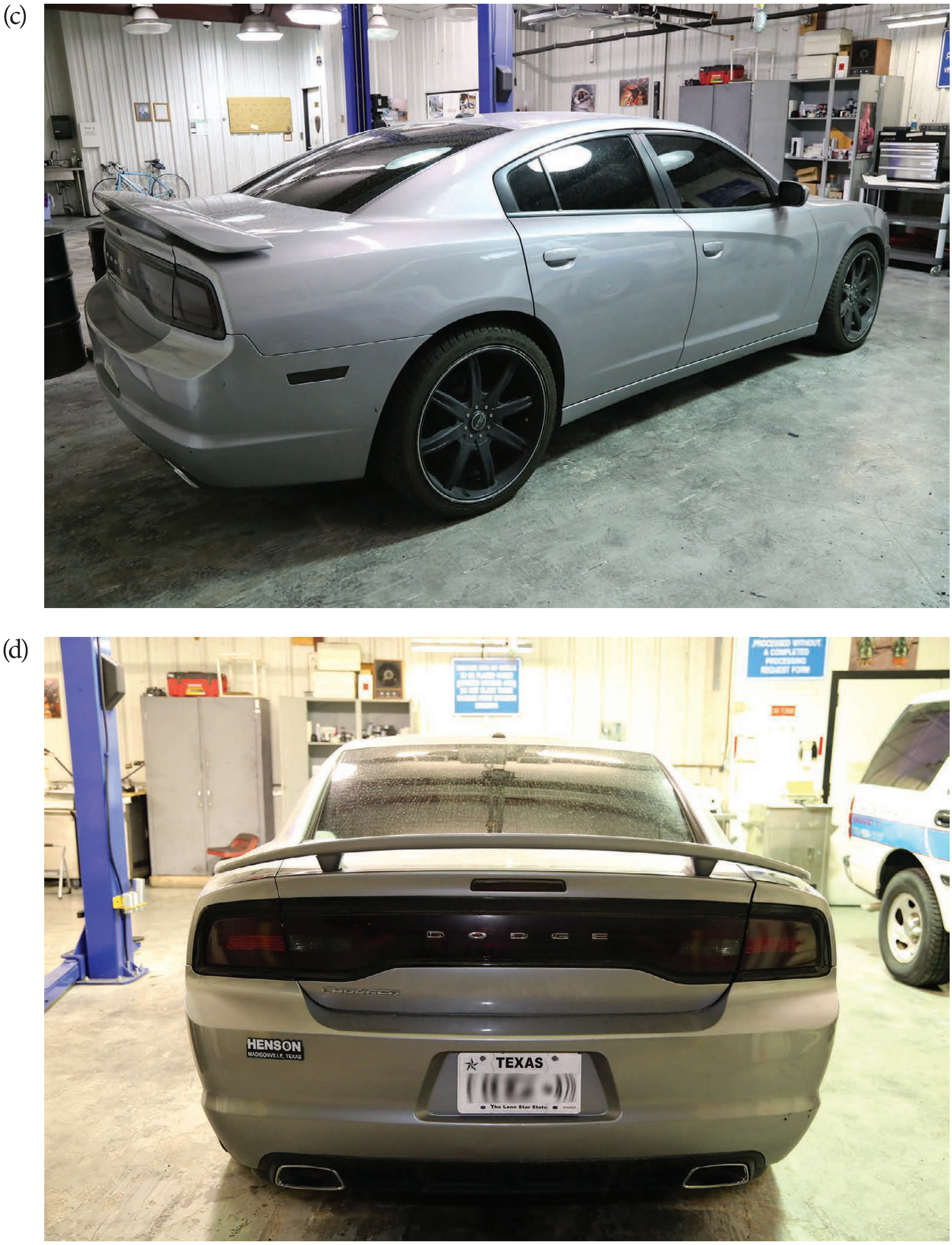


Figure 5.8 (Continued) (c) Overall photograph of the passenger's side of the vehicle. (d) Overall photograph of the vehicle's rear end.

after the trajectory rods have been inserted or identifiers placed next to the bullet holes. A photographer's mindset should be to record a complete, thorough, and accurate documentation of the vehicle and its processing.

As mentioned earlier, the photographer should avoid tunnel vision by zeroing in or focusing in on any particular piece of evidence. Even though small pieces of evidence might not be clearly visible in the big picture, the establishing nature of the photograph is still valuable. For example, a discharged pistol may be laying on the driver's side rear floorboard, but investigators must still photograph the exterior of the vehicle, each quadrant of the vehicle, including the access doors to the vehicle and what is behind them. In other words, think big and progress small. Documenting the scene or vehicle from general to specific will assist investigators in keeping a logical progression of the photographic record. The question of if a photograph should be taken need never be asked; the only question is how many photographs should be taken of a subject under inquiry. Ultimately, the photographer should think of the investigator, prosecutor, and/or jury member that were not at the crime scene and photograph the overall and entire location for them.

The goal of midrange crime scene photography is to illustrate and document the relationship between different pieces of evidence and between the evidence and the crime scene or vehicle itself. It is in these relationship photographs that crime scene photographers can separate themselves from other shutterbugs. The depth of field plays a crucial role in capturing quality relationship images. By relying too much upon a camera's Program Mode, a photographer is prevented from utilizing the full range of benefits afforded by smaller apertures. Cameras operating in an automatic mode tend to keep apertures large so that shutter speeds remain fast. The faster shutter speeds help prevent camera shake during the exposure but can seriously limit an image's zone of sharp focus. This bias toward larger apertures and faster shutter speeds is especially true in low-light conditions. In addition, a little artistry and creativity are more easily included in these midrange photographs when the photographer is capable of utilizing their complete range of apertures. Quality photographic images will only serve to impress an image's viewer with the photographer's ability, professionalism, and dedication.

SLR cameras are designed with a number of programs and automatic modes that make picture taking an uncomplicated task. Unfortunately, operating in this automatic mode prevents photographers from taking control of their work, and they might as well be using a point-and-shoot camera purchased at the neighborhood department store. SLR cameras operated in a manual mode offer the advantage of allowing the photographer much greater control over their depth of field and exposure values. As a result, better compositions and recordings will be available to investigators, prosecutors, and jurors alike. At times, a quality photograph requires the minimizing of distracting backgrounds but more often requires an increase in the depth of field so that two pieces of evidence or information are in the zone of sharp focus. This definitely applies in the field, but also applies when photographing of a vehicle. The length of a small car is approximately 15'. If the photographer has damage down the entire length of the car and focuses on the front of the car, the back of the car is likely to be out of focus if photographed in the Program Mode. Therefore, photographing in the Manual Mode and taking control of the image's depth of field is vital to recording quality midrange photographs (Figure 5.9).

After the overall and midrange photographs have been recorded, the crime scene investigator must record the close-up photographs of evidence and important aspects found on the car that relate to the vehicle's identification and the criminal investigation. Close-up photographs of evidence come in two forms. The first close-up photograph is taken of the evidentiary item or specific part of the vehicle while the subject is still in the place where it was found and how it was found. The second photograph, an examination quality photograph, is taken after the evidence item has been recovered and before packaging. These examination quality photographs are important because things like fired cartridge cases

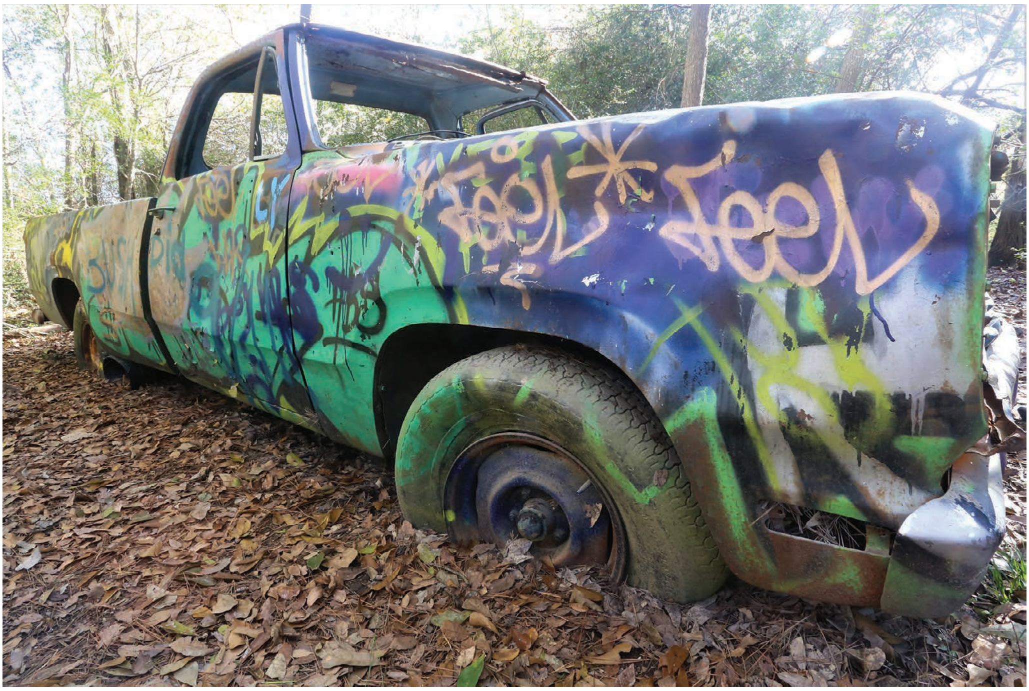


Figure 5.9 Understanding how to control an image's depth of field is important in the recording of midrange photographs so that a sharp zone of focus extends throughout the length of the vehicle. The focus on this pick-up truck was set at the passenger's door, and an aperture of f/16 was selected to ensure the truck was in focus from front to back.

and fired bullets cannot always be clearly identified when they are tucked into the tight recesses found on a vehicle.

The primary guiding philosophy of close-up photography is to "fill the frame." Filling the frame entails filling the viewfinder with the subject of the composition. Usually, this requires the photographer to get up close and personal with the subject. There is a warning that goes along with getting close to one's subject, different lenses will have different minimum focusing distances and photographers should be aware of these distances. One may be able to fill the frame with the subject, but that does not mean it will be in focus and crime scene photographers must complete both tasks to record a quality photograph. Photographers should strive to fill the frame with the subject of the composition, but filling the frame is not always the easiest task to complete inside a vehicle. Fired bullets especially have a habit of finding themselves in hard-to-reach spaces. A common location where fired bullets end up is inside passenger doors. There is only so much room one can maneuver a camera inside a vehicle's door in order to get close enough to fill the viewfinder with such a small subject. Consequently, investigators should strive to do their best to fill the frame, recording the subject in the position it was found. The examination quality photograph, in a more controlled environment, can be used to capture a better full-frame image.

Whether the photographer is capturing an image on a copy stand or inside the vehicle, orchestrating a subject's lighting is likely the greatest challenge. Lighting such close-focused objects can be a challenge because of bad reflections, shadows, or simply because the light is not striking the subject. Most, but not all, cameras come with pop-up flashes. These flashes work well for the most part, but they do have limitations. Because they sit on top of the camera, the light travels straight out and straight back to the camera, which can cause harsh reflections in an image [Figure 5.10(a)]. Photographers need to cast their light at an angle onto the subject so that the harsh reflection does not come back to the lens and only the subject is visible in the recorded image [Figure 5.10(b)]. Photographers might know this rule as "the angle of incidence equals the angle of reflection."

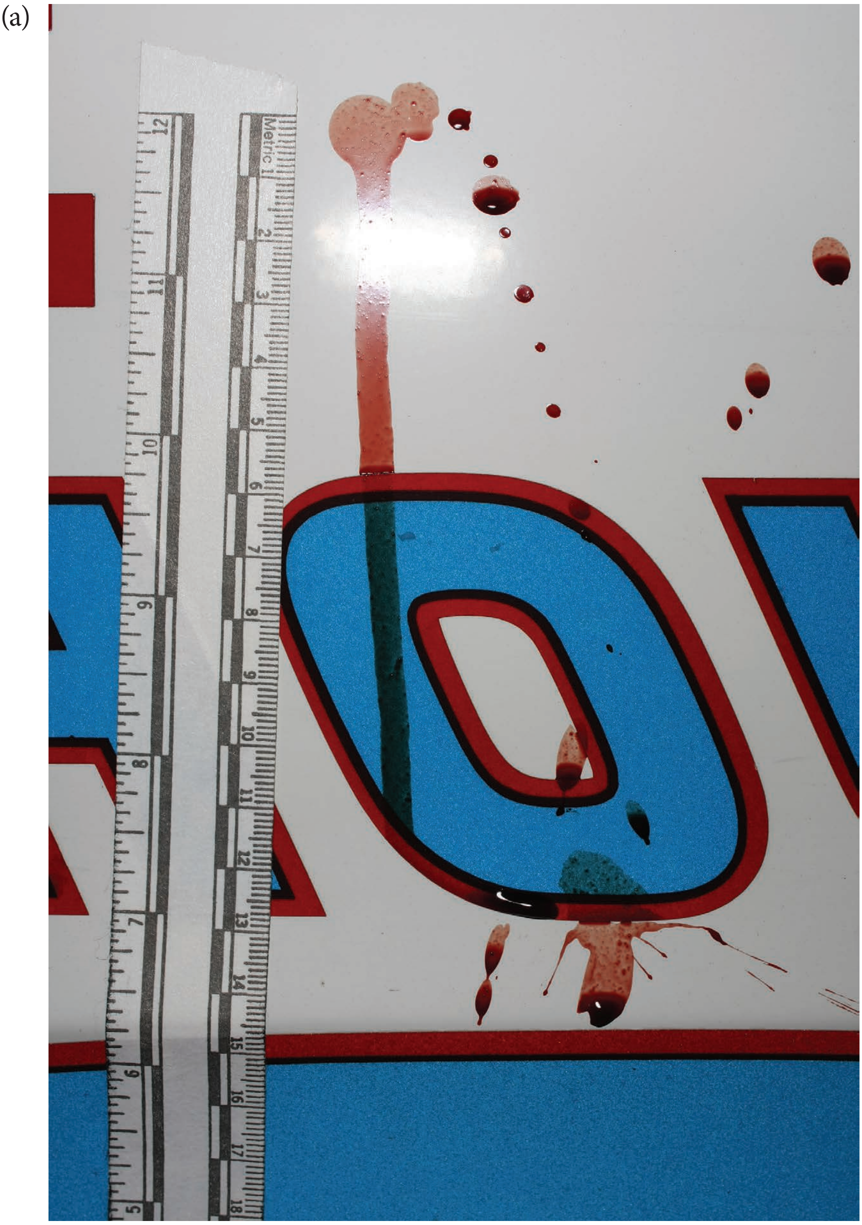


Figure 5.10 Reflective surfaces, such as high-gloss automobile paint, can create difficulties for photographers. When recording images on reflective surfaces, remember that the angle of incidence equals the angle of reflection and the flash needs to be pulled away from the camera and placed at an angle to the subject. (a) The image shows how a distracting reflection of light has been caused by a pop-up flash.

(b)

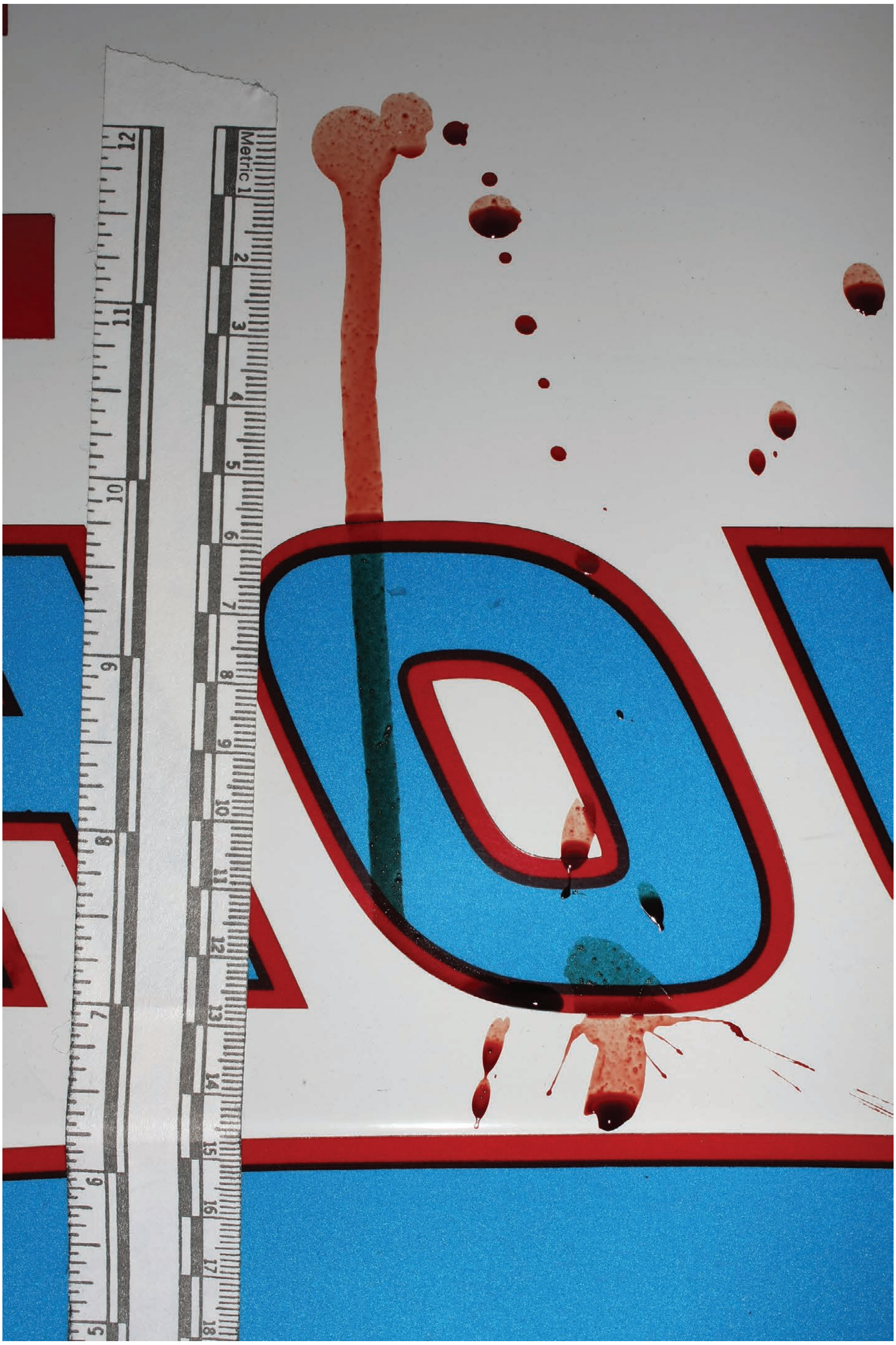


Figure 5.10 (Continued) By angling the flash onto the subject in (b), the bloodstains are much clearer and the distracting burst of light is now gone.

Lighting with flash exposures can be a challenge, even when the flash is on its TTL (Through-the-Lens) metering mode or its "Automatic Mode." The TTL mode can sometimes be problematic because of how it is designed to work. Basically, in the TTL mode, the camera meters the light coming out of the flash and as it strikes the closest object in the viewfinder and returns to the camera, the camera's flash meter determines when a "proper exposure" or 18% gray is obtained and the camera shuts down the flash. This works great when the first object in the viewfinder is the actual subject. However, if the first object happens to be a door handle and the subject is a fired bullet inside the door frame, then the light will never reach the fired bullet because the camera stops the light at the door handle. This is known as the "Inverse Square Law," which states that the loss of light is inversely proportional to the square of the distance from the source (Figure 5.11). In layman's terms, this means that there will not be enough light on the background when the light is metered by the camera and impacts some object in the foreground. Also remember, focus and flash metering are two entirely different functions in the camera. The camera can be focused on an object in the background, but the TTL flash meter will always meter the first object it finds in the viewfinder. This is more common in the overall or midrange photographs of motor vehicles, but it can still develop in close-up photographs as well.

Fortunately, there is an easy solution to this lighting problem and that is to use ambient lighting, which can be supplemented with light stands (Figure 5.12). Using a constant

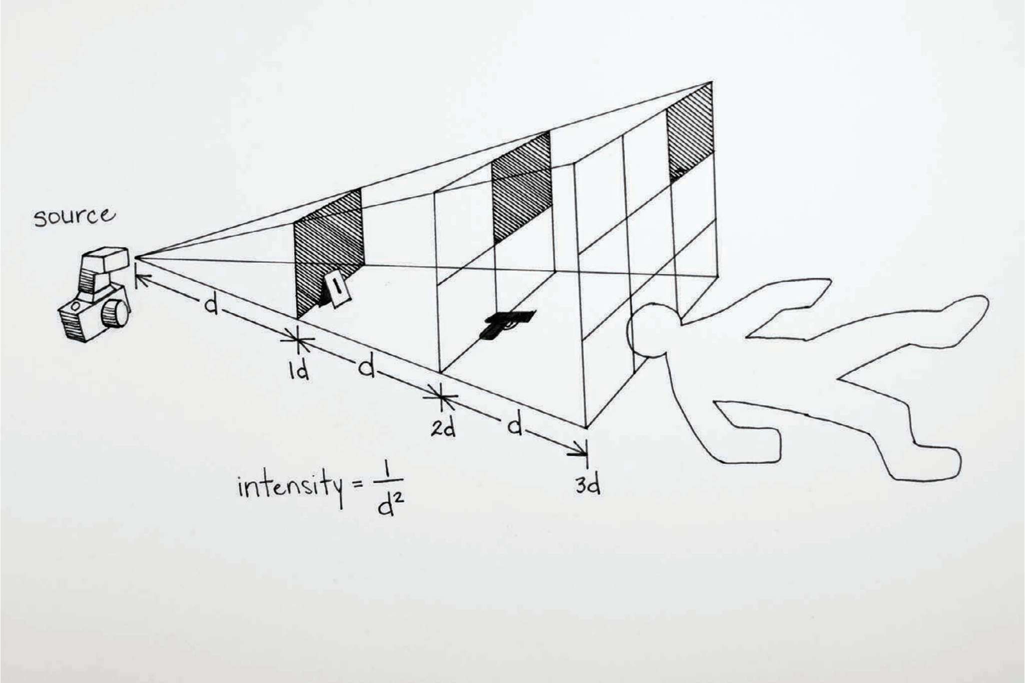


Figure 5.11 The "Inverse Square Law" states that the loss of light is inversely proportional to the square of the distance from the source and is depicted on this drawing, where the electronic flash was metered by the camera striking the evidence marker and caused an underexposure to the rear of the composition where the body is positioned. (Drawing courtesy of D. Nunez, Houston Police Department.)

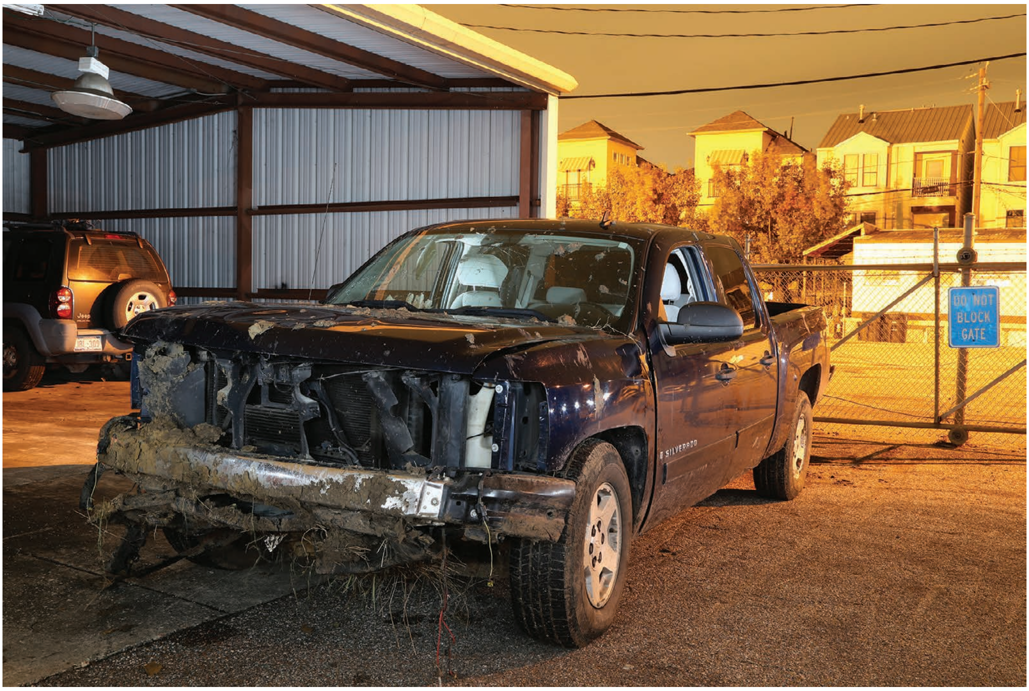


Figure 5.12 Using ambient lighting and supplemental light stands allow the photographer to easily see where the light is falling and can ensure that the composition is receiving equal lighting throughout the photograph. The light stands in this photograph were placed around the outside of vehicle as well as inside the passenger's compartment.

light source allows the photographer to see exactly where shadows and reflections are present and work to reduce their impact on the recorded photograph. LED strip lights can be inexpensively purchased and can possess a tremendous number of lumens or cast a great deal of light onto a subject. The LED lights have a couple of other benefits over other portable light stands and that is that they do not produce any heat and they produce a more true-white color in photographs. These LED light stands or light strips can also be used in close-up photography. They simply have to be positioned so that they cast an even light across the subject. In very tight quarters, such as inside of door frames or inside tires, a standard flashlight can be useful (Figure 5.13). Although the lighting might not be as evenly cast as a full light strip might be able to produce, the value of capturing such an "in situ" photograph is immeasurable. Not only does the photograph capture the context in which the evidence was found but it also demonstrates the commitment of the evidence technician to do a complete and thorough investigation to the jury.

Documenting evidence found inside or on motor vehicles initially requires that it is not disturbed during the photographic process. Therefore, the subjects must be photographed as they are found, and because of this guiding principle, not all facets of smaller pieces of evidence may be observed due to their positioning. Evidence can be caked in mud or blood, and it can be half-buried in a car door, or tucked underneath a car seat and oriented in a way that makes photographing it from an informative angle impractical. When this occurs, it becomes necessary to recover the item and, prior to submitting it into evidence, to take a more detailed photograph. This is another opportunity for a crime

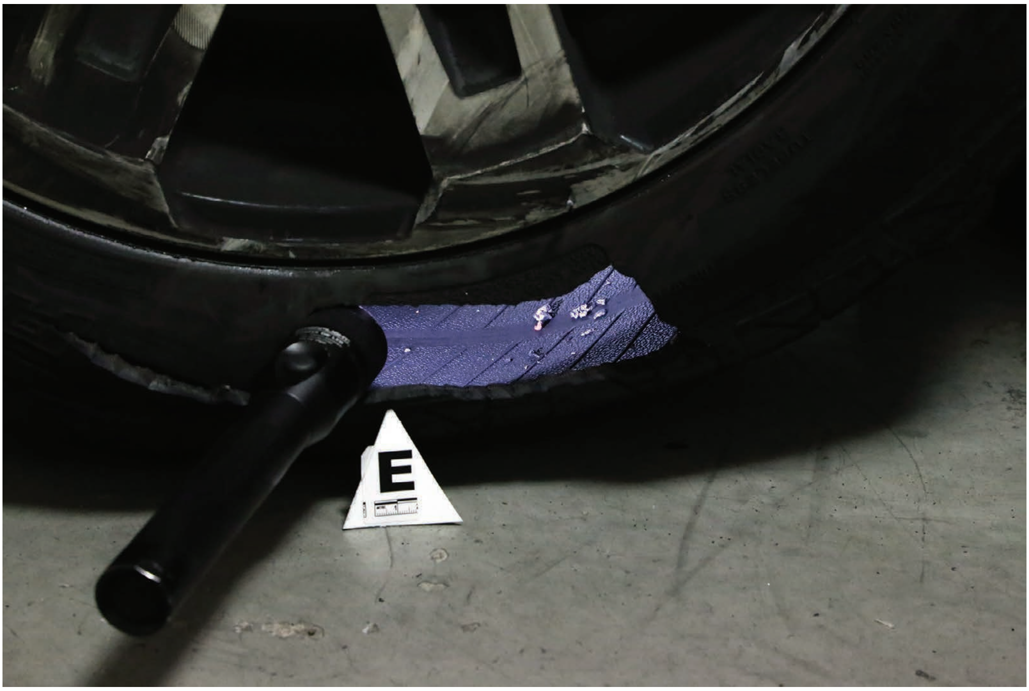


Figure 5.13 A fired bullet was located inside this vehicle's tire. In order to capture a photograph of the evidence as it was originally found, a flashlight was inserted into the tire through a hole cut into the tire. A hole must be cut to recover the evidence anyway, so the investigator can make it a little larger to accommodate a flash light and camera lens.

scene investigator to demonstrate their talent because photographs taken in a controlled environment allow the photographer to more easily adjust the lighting and composition of an image. Even the investigator who does not have a fully equipped laboratory or an evidence processing station to work with can still capture captivating and informative pictures. Crime scene investigators simply have to create their own controlled environments.

Professional light studios can cost upward of a thousand dollars but are extremely beneficial when photographing smaller subjects. Even portable light studios and light boxes can cost hundreds of dollars. Most publicly funded agencies do not have access to such high-priced equipment and must consider less-expensive alternatives. A common theme among agencies is to do more with less. With a little imagination and creativity, photographers can build their own light boxes/studios for far less than a purchased one would cost. A light box is basically a skeletal box frame covered with a monotone, translucent material (Figure 5.14). A box frame is easily created with a polyvinyl chloride (PVC) pipe. A PVC-framed light box can be easily and cheaply constructed with the following list of materials:

- Two 10' lengths of pipe (¾" or ½")
- Eight “T” connectors
- Eight 90° elbow connectors
- Two cubic yards of fabric in white, black, and gray
- Four or more clothespins

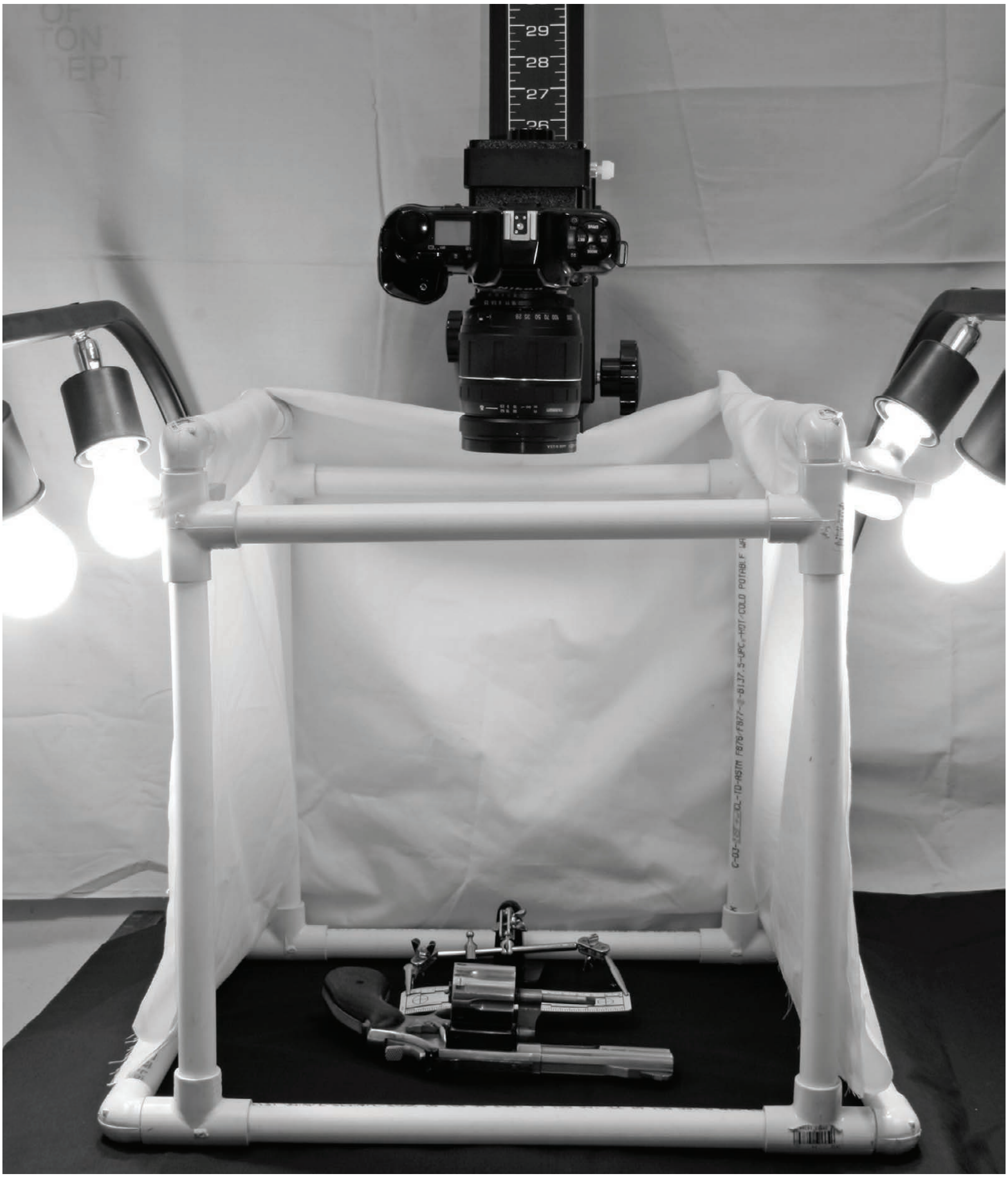


Figure 5.14 An inexpensive photo box can be built and help photographers create better lighting environments. A photographic cube, like the one seen in this image, can help with recording excellent close-focused images of recovered evidence found inside a motor vehicle.

The tubing can be either ½" or ¾" pipe. The ¾" is more rigid and costs a little more. The ½" pipe is lighter and a little more flexible but is sufficient to support the fabric. Attach each 90° elbow connector to one end of the “T” connector. One may have to fashion a connector from the lengths of PVC pipe depending on the type of connectors purchased. These eight connectors become the corners of the cube or light box. Cut the PVC pipes into 12 equal lengths. The 12 lengths of pipe will constitute each edge of the cube, and the length at which they are cut depends on the photographer’s needs and available space. However, 12"–18" lengths of pipe provide a very nice sized cube in which to position evidence for imaging. The white fabric can be draped around the box to create some quality diffused lighting. Lights can now be positioned to the side of the light box and shone through the translucent fabric for a more even and balanced light presence. The black and gray fabric can be used to create the plain background for the photograph's subject (Figure 5.15). For items that are wet or saturated in blood, place butcher paper or some other form of barrier into the light box instead of the cloth.

Sheets of plain fabric can be used as alternatives to expensive backdrops that are purchased from photo supply businesses. These backdrops can be used inside the photo cube, but they can also hang up on a wall and be used as a backdrop for the photography of people or larger subjects. At a cost of $2–$3 a square yard, different colored linens and cloths found at craft stores are inexpensive yet effective. Three basic colors are recommended: black, white, and gray. Additional colors can be purchased for specific photographic needs, but these three colors will provide contrast to any subject that may need to be photographed. The gray fabric should be consistent with an 18% gray color but does not have to be exact. Photographers do not need to have a photographic studio or even a homemade photo cube. However, it helps the photographer record more valuable images. A crime scene investigator will be judged on their work, and if soft-focused, poorly illuminated images are seen, people's opinion of the investigator will be lower.

Recording examination quality photographs is another opportunity for crime scene investigators to demonstrate their professionalism and dedication to their craft. Like the

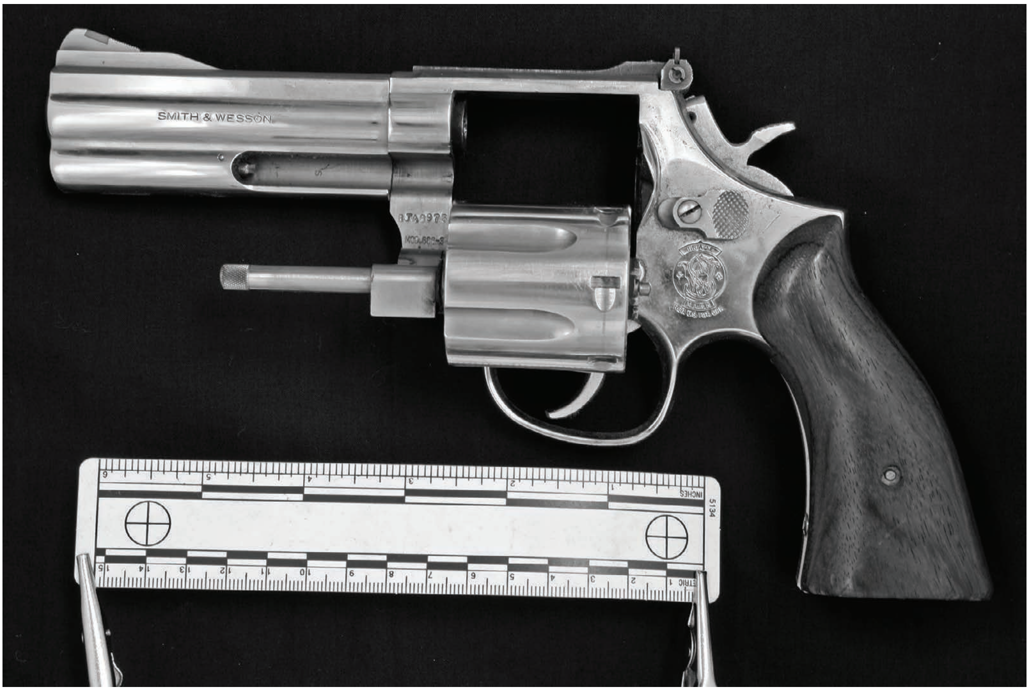


Figure 5.15 Soft lighting and a contrasting background provide the perfect combination to capture exquisite evidentiary photographs. This photograph was recorded in the photo cube depicted in Figure 5.14.

other challenging photographs recorded in the process of examining a vehicle, the examination quality photographs require the thoughtful evaluation of lighting, contrast, and subject-to-camera alignment. These are all key factors in capturing a valuable and accurate evidentiary photograph. To begin with, the camera must be securely mounted on a copy stand or a tripod. Examination photographs should not be recorded by handholding the camera. A stable camera platform will help eliminate camera shake from developing in the image. The camera's lens is best positioned perpendicular to the subject. In addition, when using a tripod or a copy stand, the photographer can more easily examine this camera-to-subject alignment and confirm that a perpendicular relationship has been achieved.

When positioning the evidence for the photo, place some form of identifying documentation next to the subject in the photographic frame (Figure 5.16). Notations might include the case number, photographer's initials, date, and some sort of identification number or letter for the composition's subject. This seems like a great deal of information to squeeze into a close-focused subject, but it is not unreasonable. These identification tags can be typed up in Microsoft Word and printed out in four-, six-, or eight-point font, depending on the photographer's desire. Placing a small identification number next to the evidence acts the same as placing numbered placards next to a series of fired cartridge cases at a crime scene. The evidence tag simply identifies the photographic subject. The small, but legible, inclusion of such information makes identifying the evidence in a courtroom much less troublesome. Furthermore, by including the case information or subject identifiers into the photograph, it acts as an excellent substitute for a photo log. A photo log is used by some agencies to document the subject of each and every photograph. This

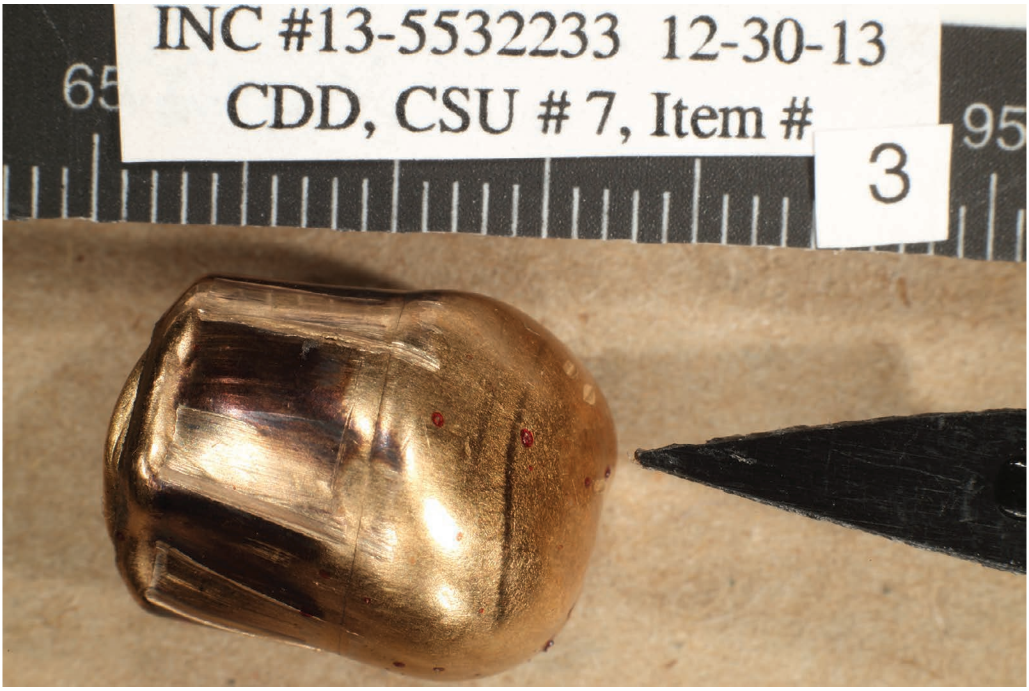


Figure 5.16 The inclusion of identifying information into one's photographs helps identify and verify the image without having to refer to a photo log. Photo tags with the case information can easily be created with a computer printer or even handwritten.

can become quite a burden for those agencies that do not have the manpower to send more than one or two crime scene investigators to the scene of a major crime. A digital camera's metadata (a photograph's recording information and data) documents all of the camera's settings, while the composition's identification tag informs the viewer what the subject is. Consequently, there is no longer the need to maintain a formal photo log, unless one's standard operating procedures still require a photo log to be completed. Investigators must follow their agency's protocols, but digital imaging has definitely decreased the need to maintain paper photo logs.

A suitable scale or ruler should also be included in the image and placed in the same focal plane as the fingerprint or piece of evidence (Figure 5.17). Maintaining the same plane of focus is important because it ensures that both the subject and the scale will be accurately focused. There is another alignment issue that investigators should strive to maintain. Because the imaging chip used in digital cameras are primarily created by light-capturing diodes arranged into rows and columns, it is recommended that any scales included into a composition be aligned with the edges or sides of the viewfinder or image. Placing a scale across the diagonal of the imaging chip's mosaic of pixels could potentially create an error in any scale measurements made from the final recorded image.

Many investigators use preprinted adhesive stickers similar to address labels for their examination quality photographs. The use of stickers saves time, but an investigator can also handwrite the identification information on a small slip of paper or an index card and place it next to the subject. Although this amount of information and effort may seem excessive, the value of protecting the chain of custody is invaluable. Fully documenting

(a)

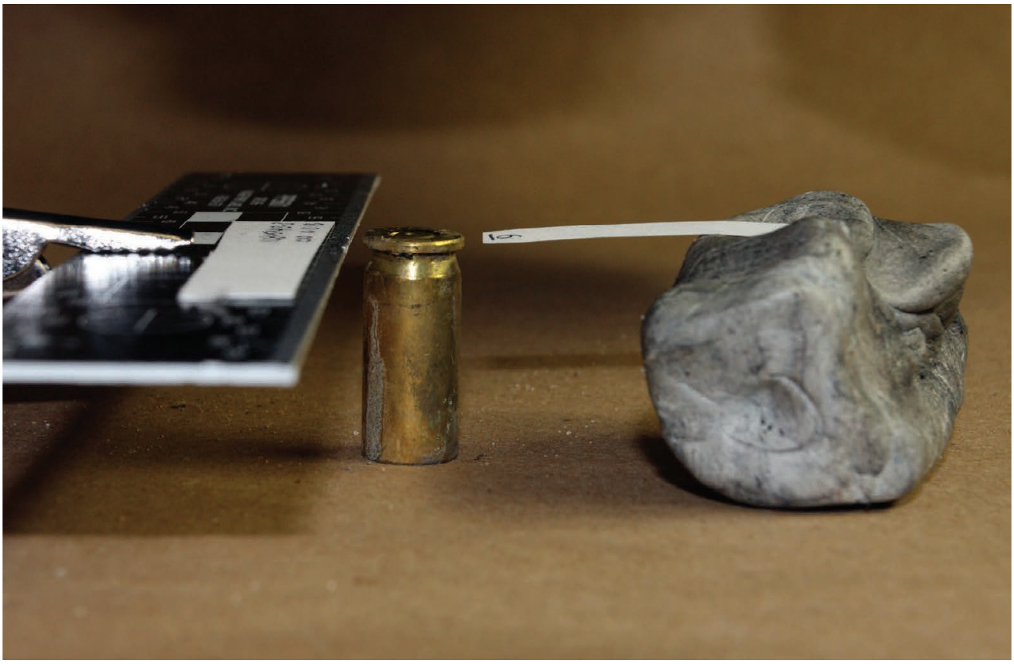


Figure 5.17 (a) The proper set up of an accurate, close-focused image requires the scale and/or identification tag to be placed on the same focal plane as the subject.

(b)

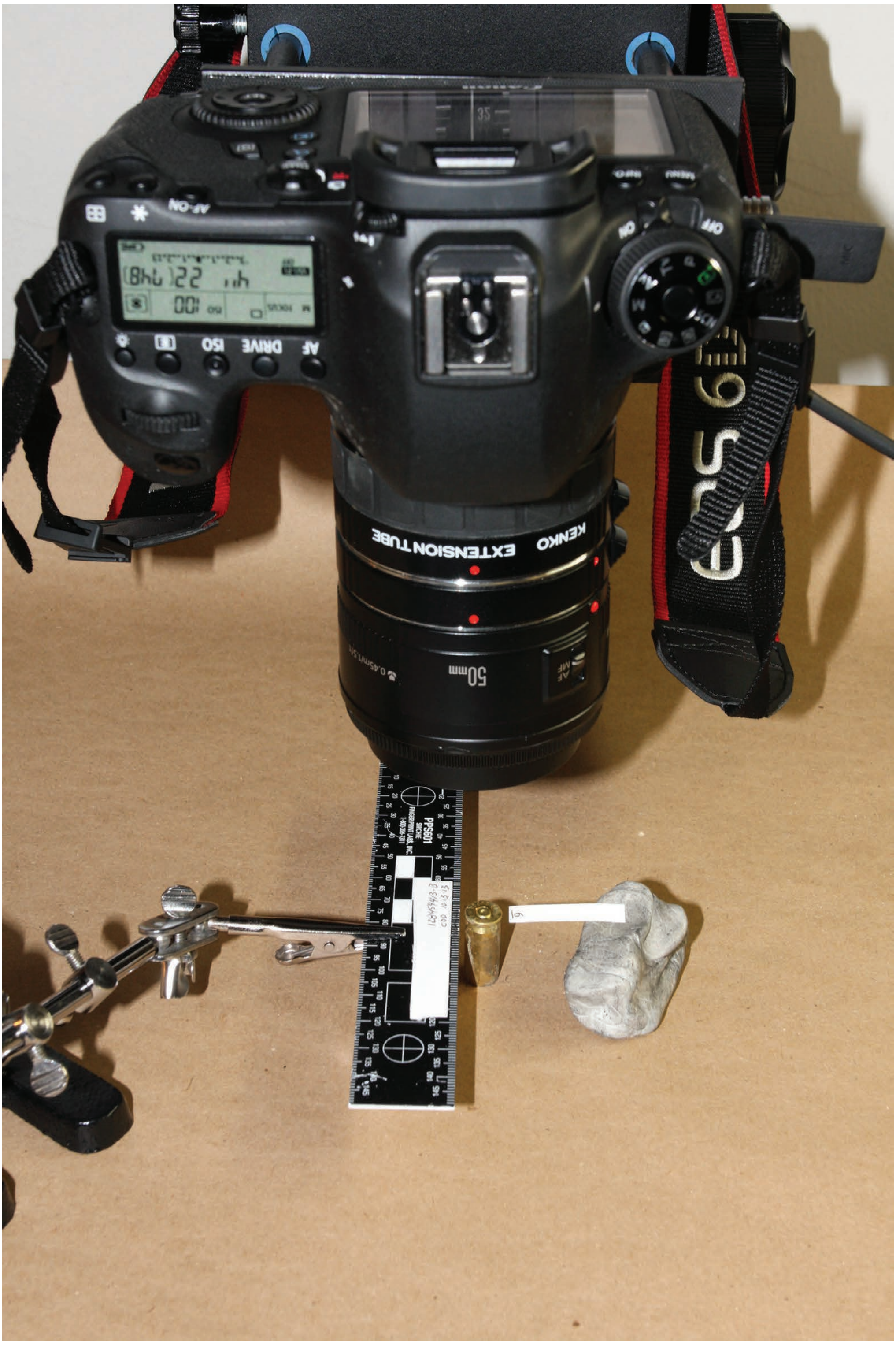


Figure 5.17 (Continued) (b) The scale and/or identification tag should be aligned parallel with the camera's imaging chip or viewfinder.

the scene's evidence is vitally important, and a series of photographs documenting a single piece of evidence may resemble something like the following hypothetical live 9 mm cartridge found in a Beretta semi-automatic pistol's chamber. Someone that is looking through an investigator's photographic documentation of a vehicle should be able to link the live cartridge with the vehicle's identification in a fully connected series of photographs (Figure 5.18). The following set of photographs can be recorded in order to fully document the exact location where the live cartridge was found:

- *Overall view*—Photographs showing the vehicle and its license plate
- *Midrange view*—Photographs showing the driver's side of the vehicle
- *Midrange view*—Photographs showing the driver's door open and the driver's seat
- *Close-up view*—Photographs showing the Beretta pistol underneath the driver's seat
- *Close-up view*—Photographs showing the cleared weapon and associated ammunition
- *Examination quality view*—Photographs showing the live cartridge(s)

Both the close-up views and the examination quality views should have an identification tag visible in the picture and providing the key case information and identification of the subject. Recording sharp-focused, well-illuminated photographic images throughout the processing of a motor vehicle is a very important skill for the crime scene photographer.

(a)

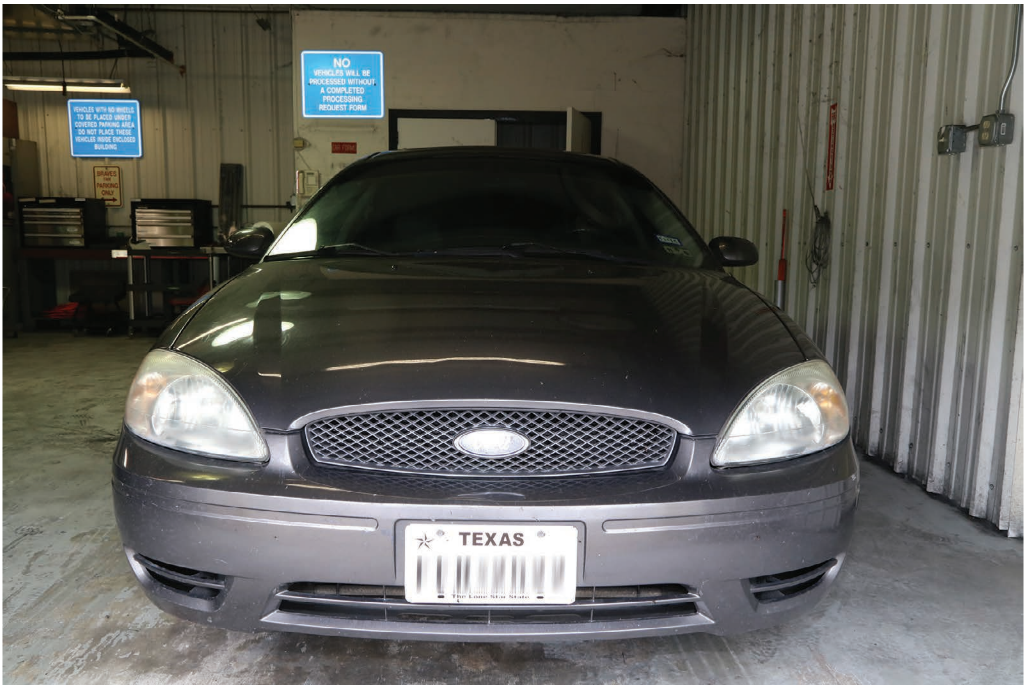
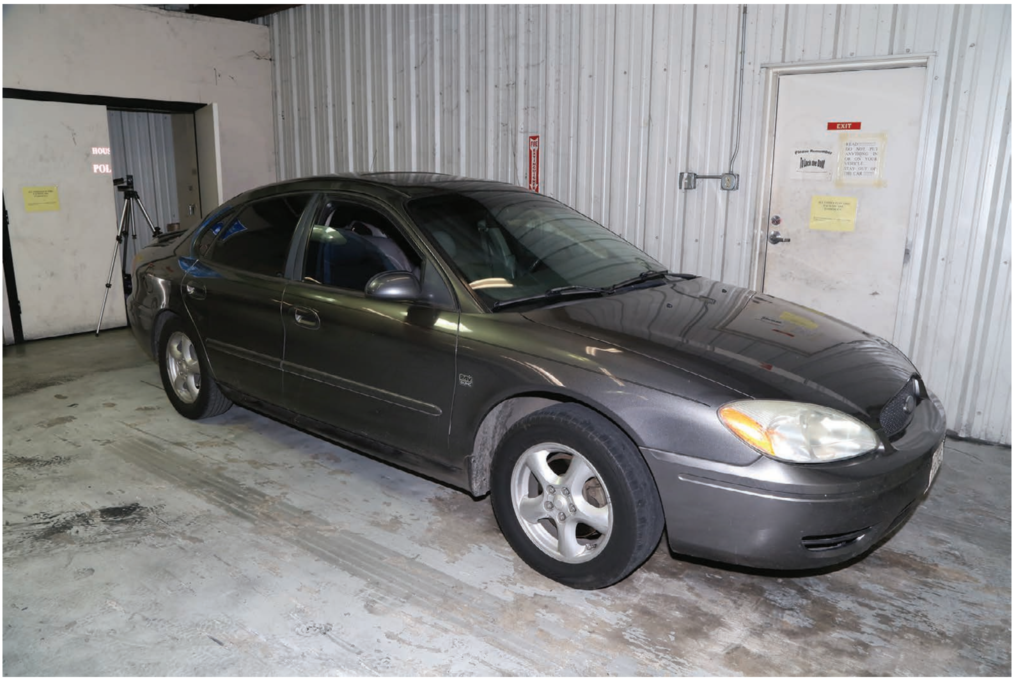

NO VEHICLES WILL BE PROCESSED WITHOUT A COMPLETED PROCESSING REQUEST FORM
TEXAS

Figure 5.18 (a)–(e) A series of photographs that show a continuous linking of images in order to show where a loaded firearm was found inside the vehicle. The photographic record should be able to tell a continuous story, even for those that have no firsthand knowledge of the investigation.

(b)



(c)

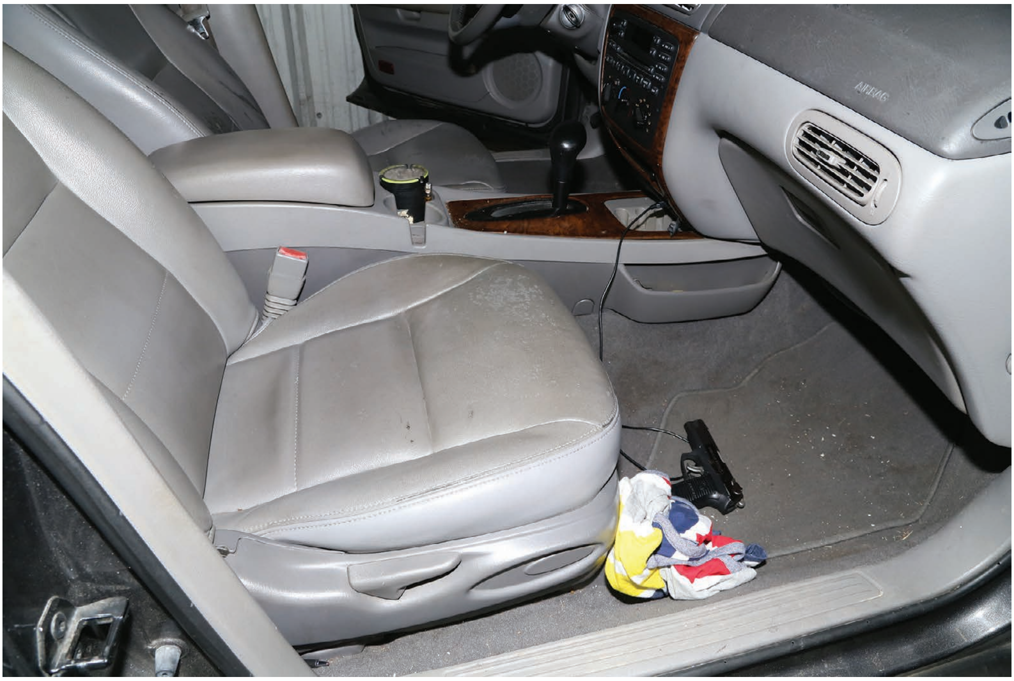


Figure 5.18 (Continued)

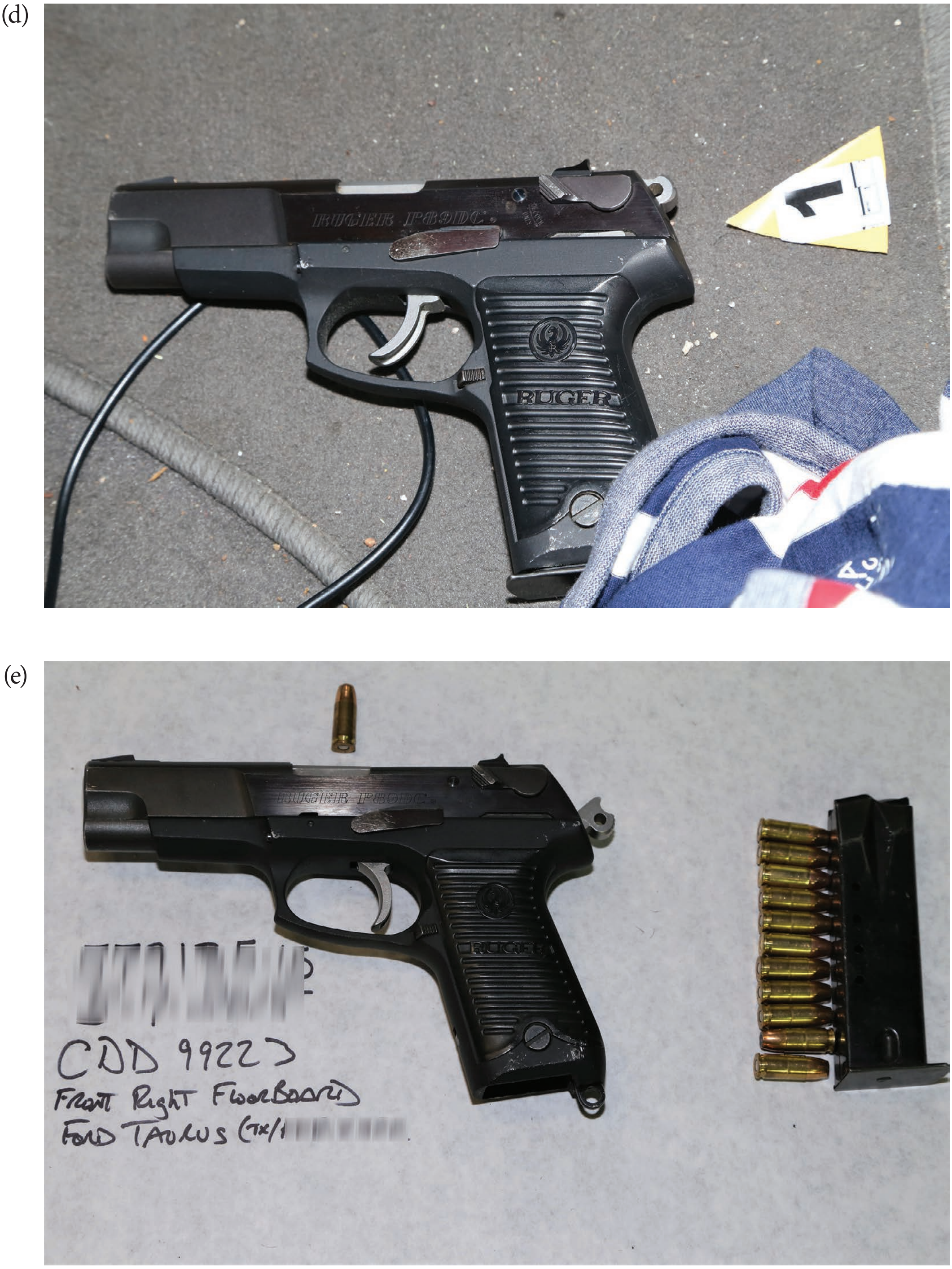

(d)
RUGER P89DC
RUGER
(e)
RUGER P89DC
RUGER
[redacted]
CDD 99223
Front Right Floorboard
Ford Taurus (TX/[redacted]

Figure 5.18 (Continued)

Evidentiary photographs have many purposes, but none more important than providing the jury with a true and accurate representation of the crime scene and any recovered evidence. If those evidentiary photographs are not properly focused, illuminated, and composed, then the jury will likely have doubts as to the competency and capability of the investigator. Therefore, it is extremely important that photographers take the extra effort to record truly exceptional evidentiary photographs.

Illuminating minute pieces of evidence can be difficult because of reflective surfaces, backlit subjects, or confusing backgrounds. Fortunately, different types of lighting and compositional arrangements may help eliminate such problems. Photographers need to examine difficult compositions, identify the challenges, and determine the best method to address those challenges. As a friendly reminder, crime scene photography is not simply a point-and-shoot endeavor and hoping for the best outcome without a little thought, planning, and execution is asking for trouble. Lighting small individual pieces of evidence can be a challenge, but with a little effort and thought, outstanding evidentiary photographs can be recorded. Many crime scene photographers are familiar with the nighttime photography technique of painting with light. This technique is a way in which photographers can add light to lowlight compositions in order to record brilliantly illuminated photographs. This painting-with-light technique can be applied to very small subjects, such as insects, fired bullets, and other small pieces of evidence, as well as overall crime scenes.

A major difficulty created by subjects composed so close to the camera lens is the inability of light to reach into and around the subject. Many subjects are not flat or reside on a single plane of focus. They will have curves, crevices, and areas of shadow that must be addressed in a composition. As a result, flash photography or ambient light photography alone may not be able to produce a quality photograph. Compare the photographs depicted in Figure 5.19. Figure 5.19(a) was created with a flash. Figure 5.19(b) was created with ambient light from a stationary light source. Figure 5.19(c) was recorded by painting the subject with light, which will be discussed later.

Painting with light is the process of adding light to a composition in order to increase the details found in the areas of shadow. This procedure is most commonly done in outdoor crime scenes photographed at night, but the technique can be adapted for use in macro and/or close-up photographic endeavors. The basic principle of painting with light is that light is additive. Light does not have to be added to a composition all in an instant. It can be added to a subject over time, so that the cumulative amount of light applied to a subject creates a powerful and well-illuminated photograph.

What follows is a description and discussion on photographing a close-focused subject. Where to begin the recording of a difficult composition is usually the most challenging part of the entire photographic process. Everyone’s approach to photography is slightly different, but hopefully, the goal is the same: capturing an accurate representation of the subject. The first step should be to stabilize the camera on a copy stand or a similar device and attach the remote or shutter release cable. Set the camera for manual focus and manual exposure. Unless the photographer has a particular preference, one should consider an ISO value of 100, because the recorded images are generally sharper and have better color saturation than higher ISO values. The aperture should be set to the smallest available setting, especially when the subject has any depth to it. The final exposure variable is the length of the exposure (shutter speed) and that will be determined a little later.

The next task is to compose the actual subject. The subject should fill the viewfinder and the camera placed parallel to the subject (lens perpendicular to the subject). This may

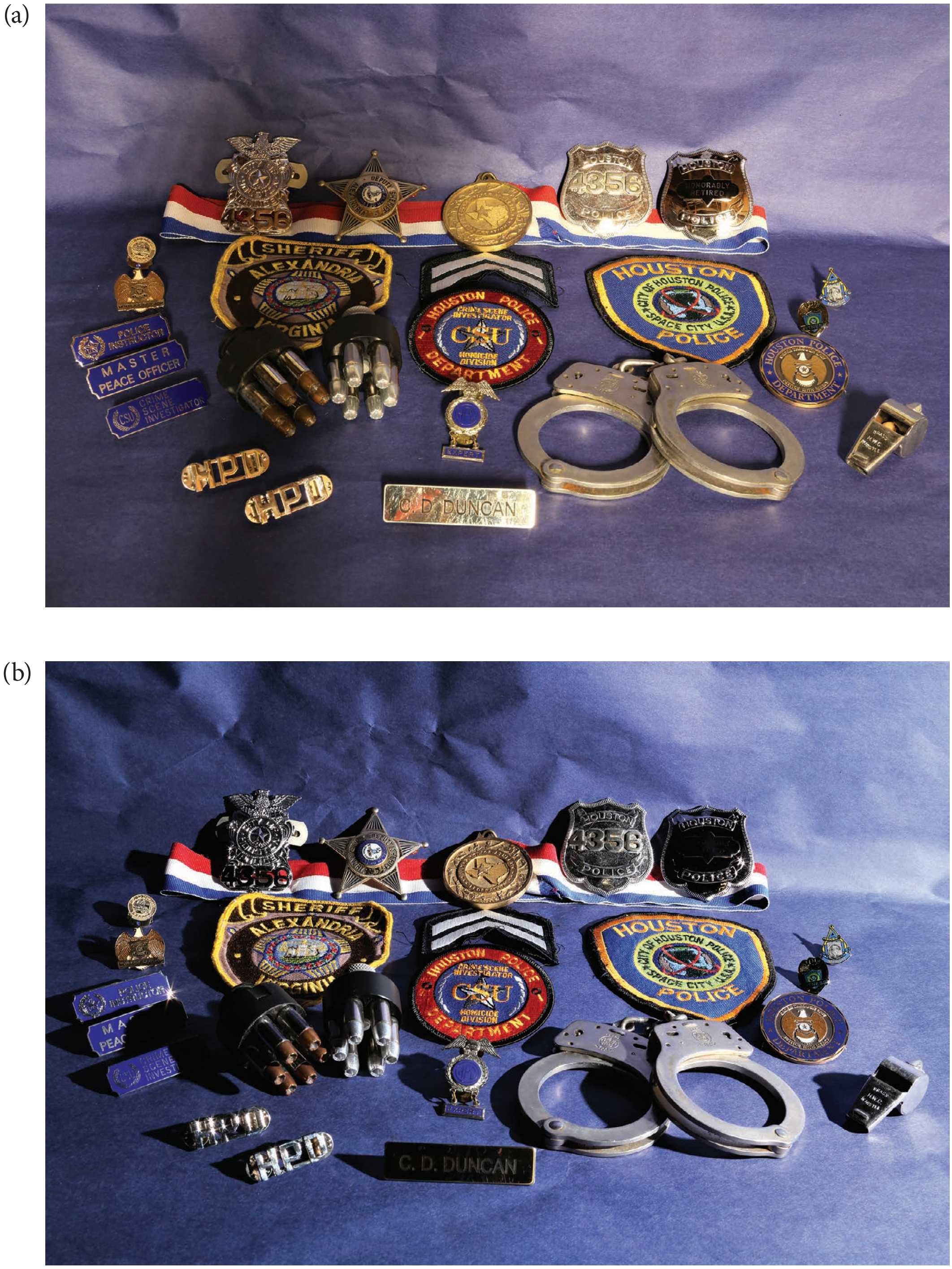


Figure 5.19 The law enforcement regalia pictured in these images have naturally occurring shadow areas that develop when a single light source is used to record the image as evidenced by images (a), which was recorded with an ambient light and (b), which was recorded using a single electronic flash.

(c)

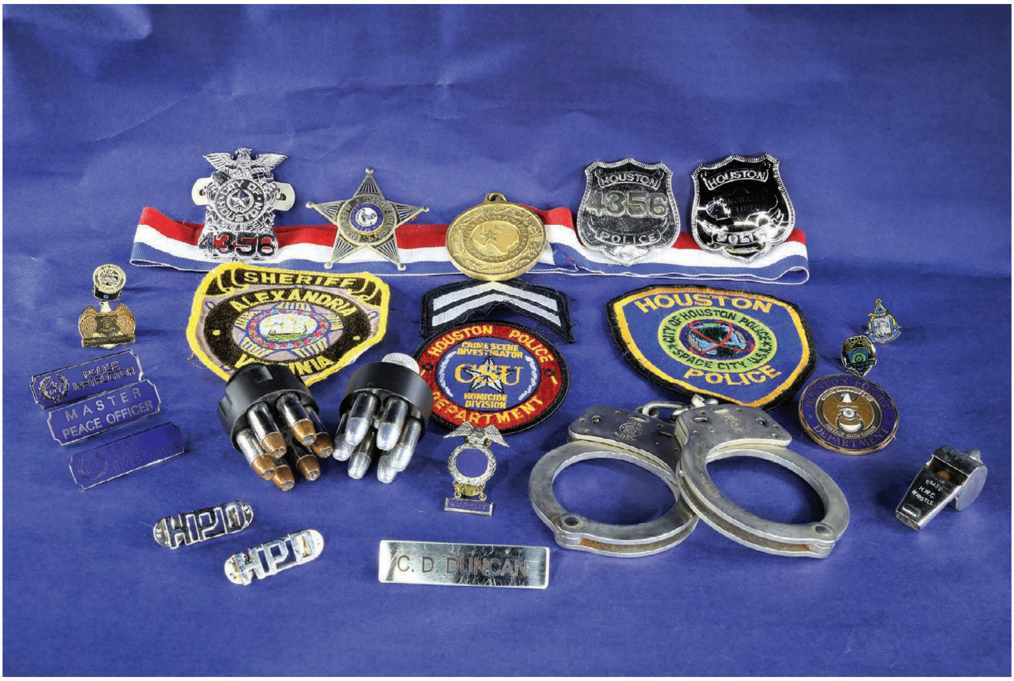


Figure 5.19 (Continued) By combining multiple bursts of flash and ambient light in the same composition (c), one captures a much better light-balanced photograph.

not be necessary for a round- or spherical-shaped subject, but any and all scales should be parallel to the film plane (or imaging chip). If at all possible, consider raising or elevating the subject above the level of the copy stand's base, as is demonstrated in Figure 5.20. By elevating the subject, the background will be blurred or not even visible in the image and therefore, not competing with the subject for the viewer's attention. Raising the subject away from or above the background will move the background out of the zone of sharp focus. Furthermore, the inverse square law will be applicable during the application of light to the subject, thereby limiting the light striking the background and allowing the subject to be isolated or separated from the background. Consider having a black or other light absorbing background for the composition. The black background will help absorb stray light during the painting-with-light procedure. A solid white background could also be considered, if it provides a good contrast with the subject. As one can see, proper composition is much more than a point-and-shoot endeavor. Compose the image to show the best side or facets of the subject and have a purpose for the composition; do not simply capture a haphazard or random image. Finally, manually focus the subject so that the depth of field is maximized and as much of the subject is in the zone of sharp focus. Remember that in extremely close focusing compositions, the zone of sharp focus extends approximately one-half forward and one-half rearward of the point of actual focus, instead of the standard one-third to the front and two-thirds to the rear.

As with any macrophotograph, the depth of field and image composition are extremely important. In regard to composition, one should strive to have the subject fill the viewfinder. When composing small pieces of evidence in the camera's viewfinder, one can easily see the need for a close-focusing lens or set of extension tubes. It may be necessary for

(a)

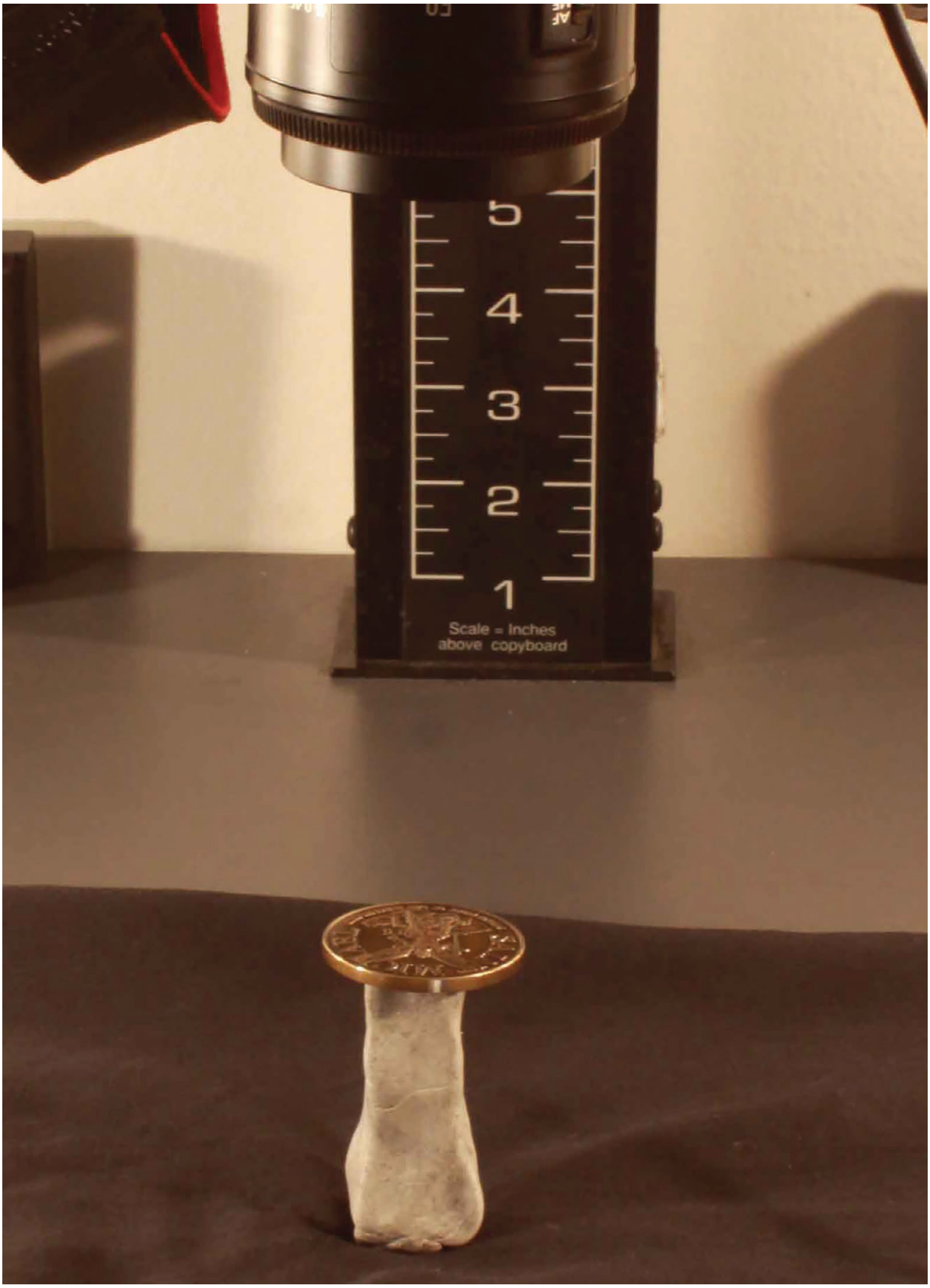


Figure 5.20 When a photographer is in need of removing a distracting background from a close-focused image, one can create distance between the subject and the background and choose a larger aperture. The combination of these two actions will at the very least blur, if not completely remove, any distracting background. Image (a) illustrates the manner in which the St. Michael's coin was raised away from the background, and image (b) shows the end result.

(b)

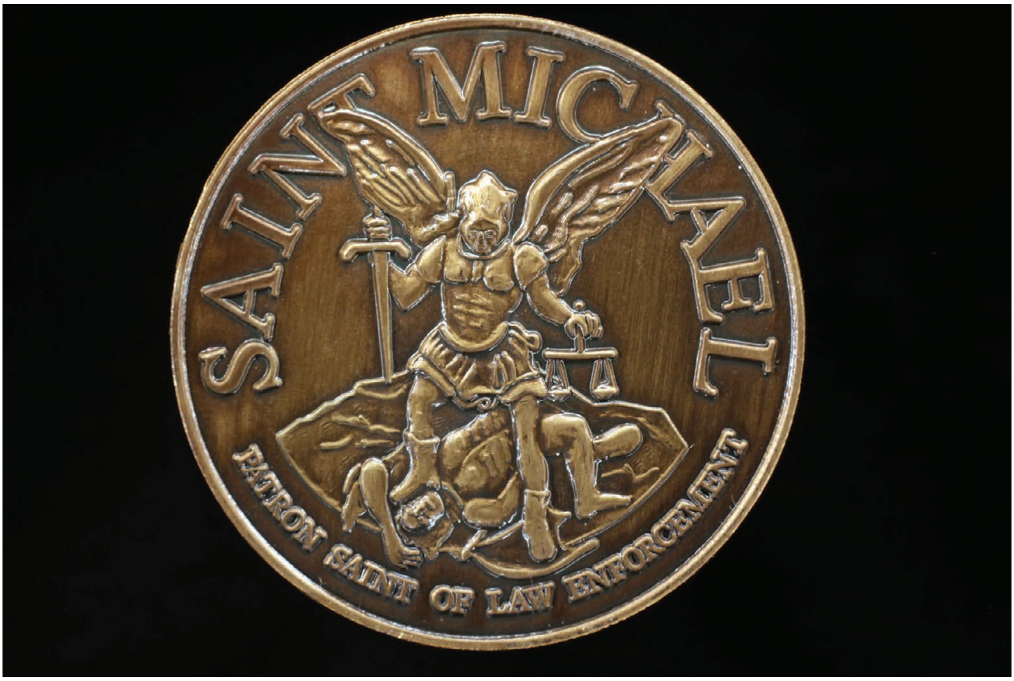


Figure 5.20 (Continued) The exposure values for image (b) were ISO 100, f/22, for 2 minutes and light was cast across the coin with a small penlight flashlight to further eliminate the background by limiting the light that could reflect off the background.

the lens to be just a centimeter away from the subject in order to fill the viewfinder. Being so close to the subject will cause two major difficulties. First, lighting the subject will be a challenge, which is the purpose of painting one's subject with light. Second, the depth of field suffers tremendously by having such a short focusing distance. The zone of sharp focus will be extremely shallow in close-focusing situations. Because of this fact, the focus point must be carefully selected and a proper aperture chosen. A camera's autofocus feature will generally focus on the subject closest to the camera's lens, and this will effectively reduce one's potential zone of sharp focus by half. In addition, the camera may not select a focus point that is of primary importance to the photographer. The actual point of focus should be placed on the most important aspect of the composition and in approximately the middle of the subject's range of focus in order to maximize the overall image's depth of field. In addition, the photographer should select the smallest aperture available on the camera's lens. Smaller apertures will help maximize the depth of field, like the blood-stained bullet depicted in Figure 5.21.

With the aperture and ISO selected, it is time to determine the shutter speed or the length of the exposure. The length of the exposure will depend on the particular light source used by the photographer, whether it is bright or dim. Although some ambient light can be incorporated into an image, for now, turn off all the lights in the work area and only illuminate the subject with the selected light source. Once again, remember that it is the accumulation of light during the entire painting process that will create the final image. With the ambient light restricted or not even present, low ISO values, and smaller apertures, be prepared for the length of the exposure to possibly be minutes rather than seconds long. A starting point for determining the length of an exposure is to aim the

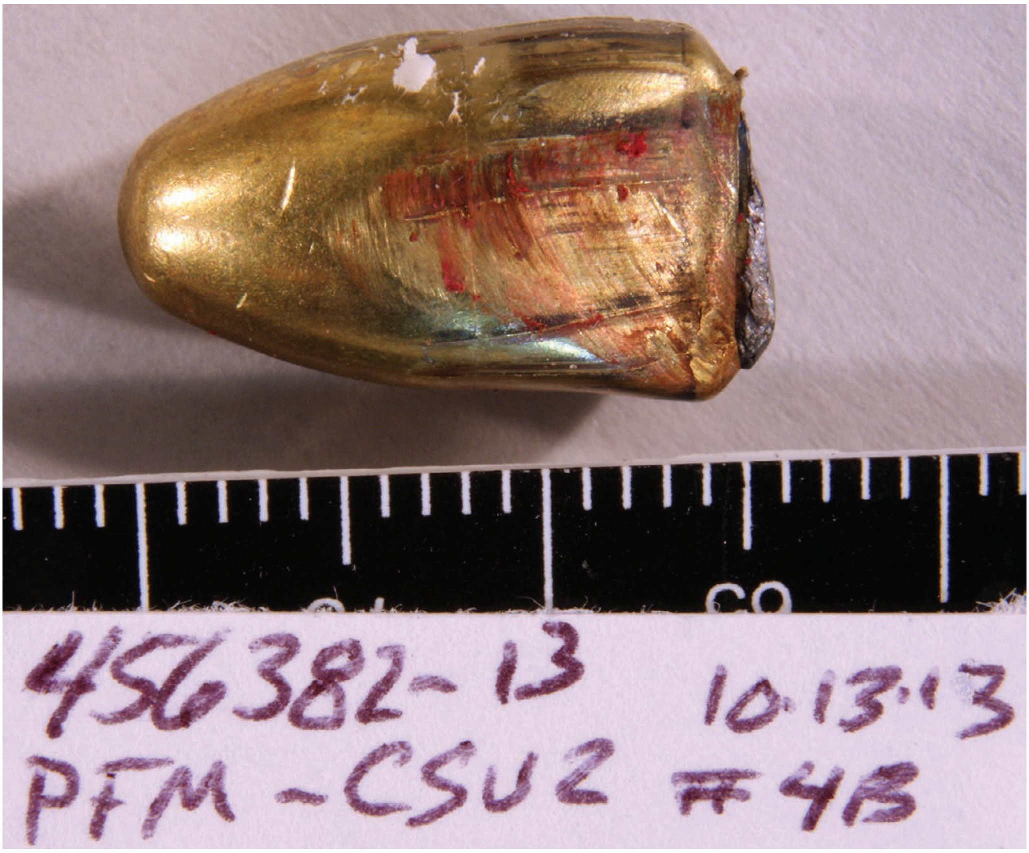


Figure 5.21 Closely focused images will be severely affected by the depth of field, and the subject's focus and sharpness can be detrimentally affected. Photographers should strive to manually select their point of focus and choose a smaller aperture (f/22 in this image) in order to maximize the image's depth of field and the image's overall focus.

selected light source at the subject and use the camera's light meter to determine the length of the exposure (Figure 5.22). The length of the exposure can be adjusted slightly by physically moving the light closer (thereby shortening the exposure) or farther away (thereby lengthening the exposure) from the subject. The final exposure's length may not be exactly what was determined in this evaluation process, but it should be within a couple of stops and give the photographer a good starting point for the exposure.

Because these subjects are small pieces of evidence and not expansive crime scenes, the light source selected to paint one's subject should be equally small. Single-bulb LED and small penlight-style flashlights are preferable for use in these small compositions. One could use stronger, more powerful light sources, but the risk of overexposing the image or creating hot spots in the image will increase. In addition, by using less powerful light sources, one has the ability to apply the light more evenly and into and across the small crevices and undulating surfaces that might be found on the subject. Flash exposures and more powerful light sources will speed up the process of photography. However, by using less powerful light sources, the creativity, depth, and brilliance of the composition can be improved markedly. Practice photographing with one's favorite flashlight will make the exposure evaluation

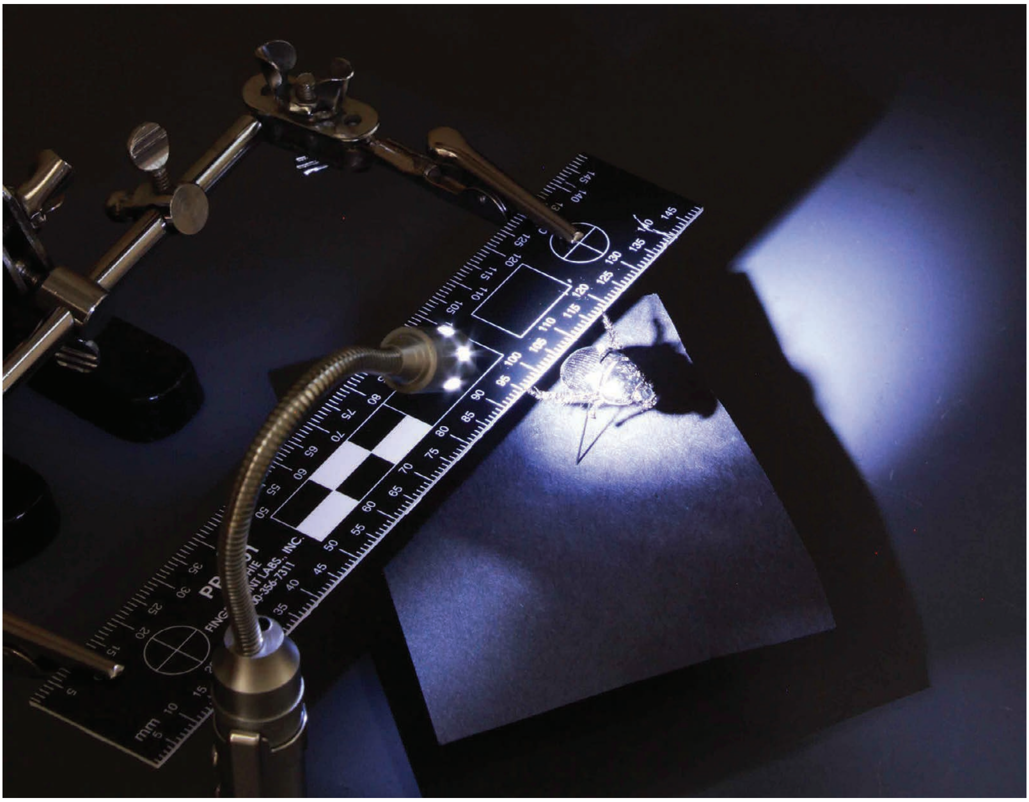


Figure 5.22 Finding a starting point for how much light to let into the camera (metering light) can be accomplished by holding or aiming one's light source directly onto the subject from approximately the same height or distance from the subject that the subject will be painted from. The camera can meter the composition for an approximate exposure value. The photographer should be aware that the exposure time may be slightly longer than suggested by the camera because the light will be moved across the subject and not shining on the subject 100 percent of the time.

much easier in subsequent endeavors because the length of exposures will remain relatively constant as long as the choice of apertures and ISO values remain the same.

The main purpose of painting small pieces of evidence with light is to ensure that the subject is illuminated on all its surfaces and limit the amount of distracting shadows that may develop on items with undulating surfaces. The casting of light onto the evidence is similar to painting an outdoor crime scene. Add light evenly across all the subject's surfaces, circling around the subject during the entire length of the exposure. It is advisable to wave the light back and forth as it encircles the subject. What this painting effect might look like is shown in Figure 5.23. There will be times when the casting of light will be unintentionally passed over or off the subject, but that is expected and is easily overcome by adding a little more time to the exposure. Practicing this technique will provide the photographer more confidence in their ability to produce brilliant and compelling pieces of photographic evidence. As examples of odd-shaped subjects with a multitude of different surfaces, painting with light on a macro scale is an excellent tool to photograph entomological evidence [Figure 5.24(a) and (b)], ballistic evidence [Figure 5.24(c)], and jewelry or other small [Figure 5.24(d)], colorful items that might find their way into one's investigation.

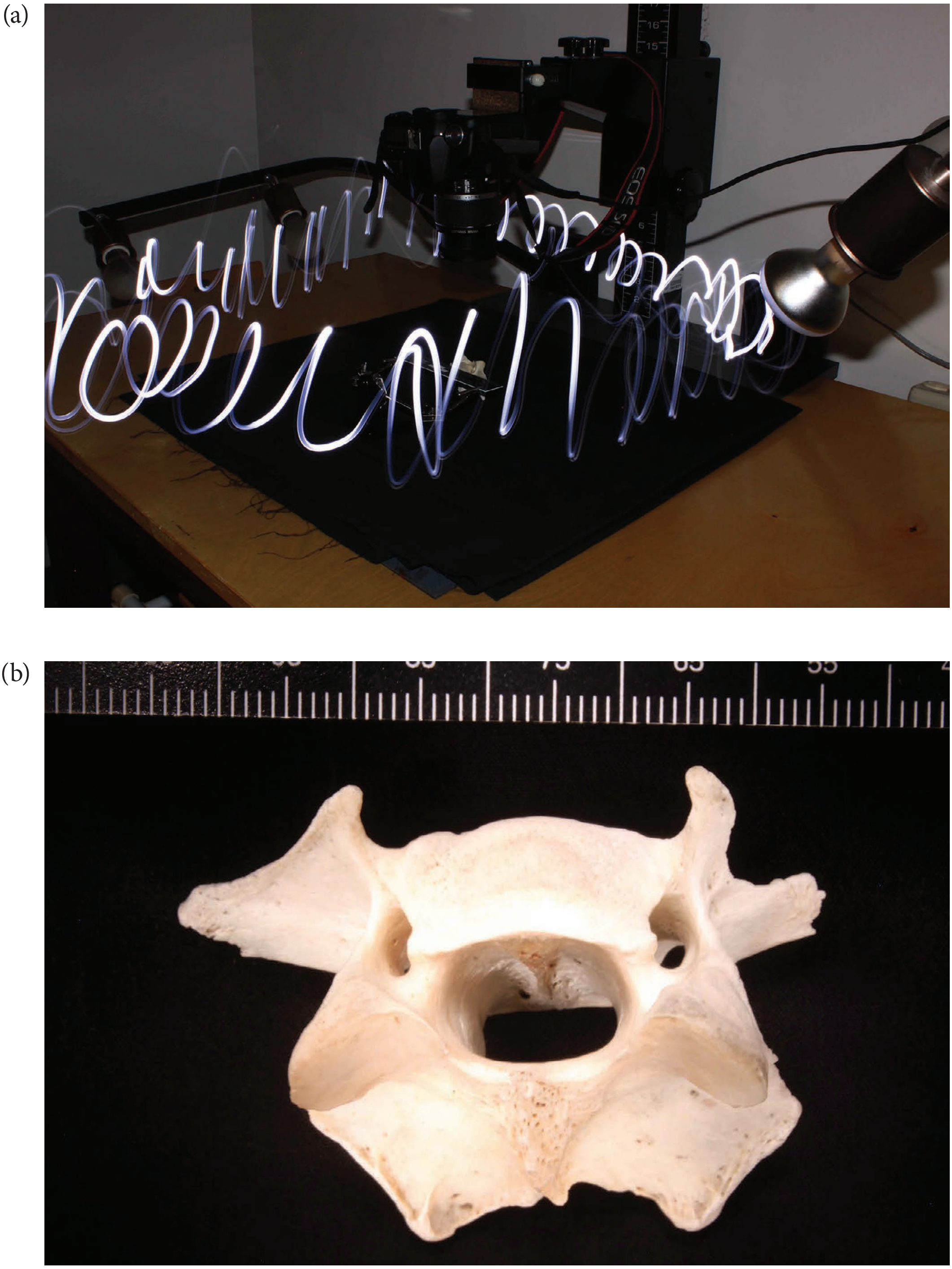


Figure 5.23 (a) The casting of light across the subject from all sides to provide equal illumination across the entire subject. (b) The resulting image from (a), and the light source was a single-bulb LED flashlight. The image was recorded at ISO 100, f/36, for 30 seconds.

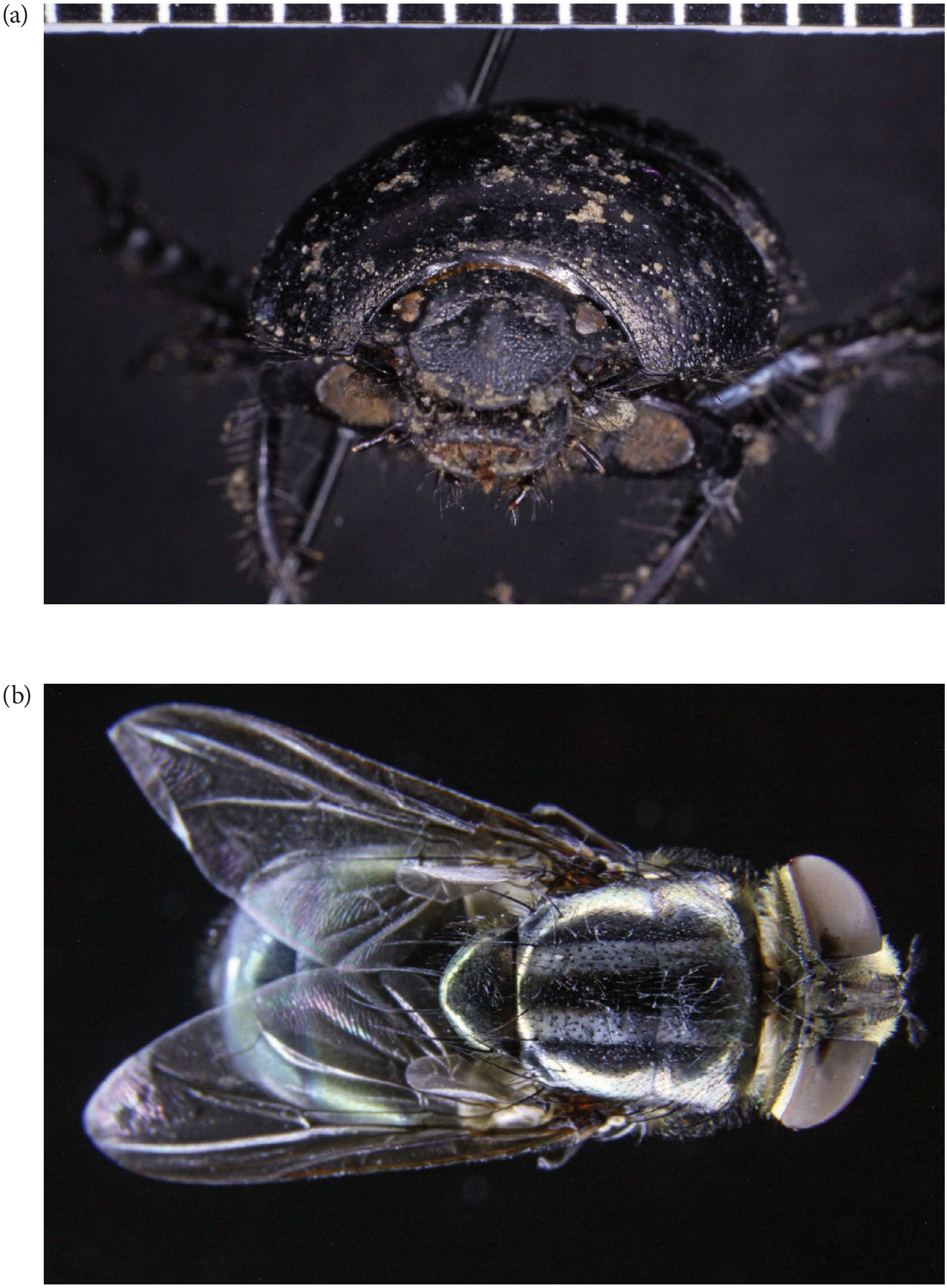
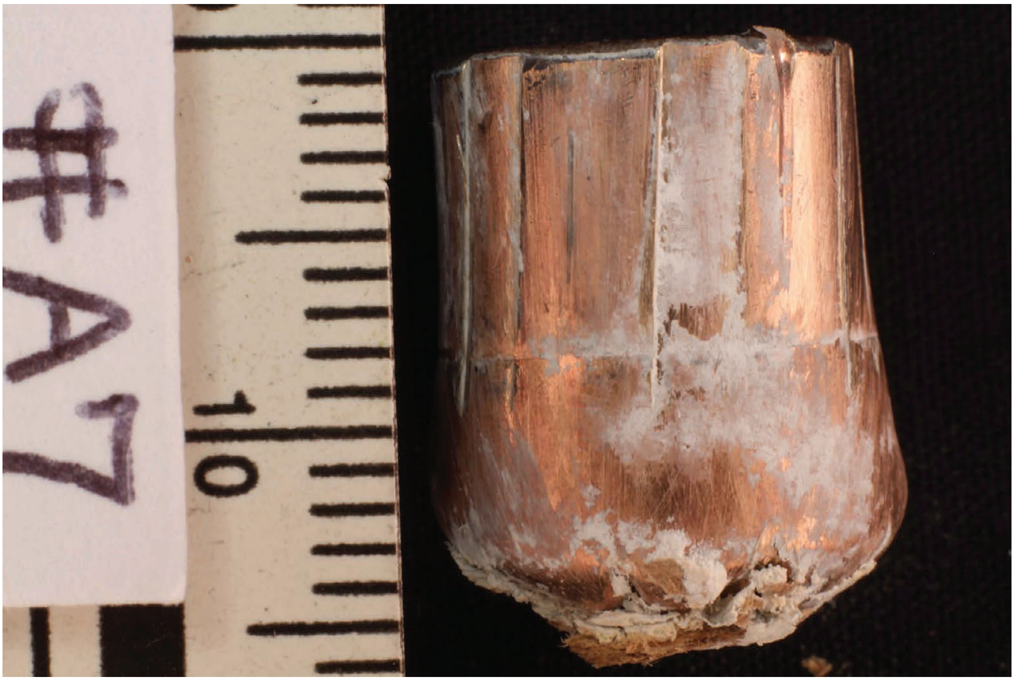


Figure 5.24 (a and b) Examples of entomological evidence. Image (a) was recorded at ISO 400, f/22, for 30 seconds and image (b) was recorded at ISO 400, f/25, for 100 seconds.

(c)



(d)

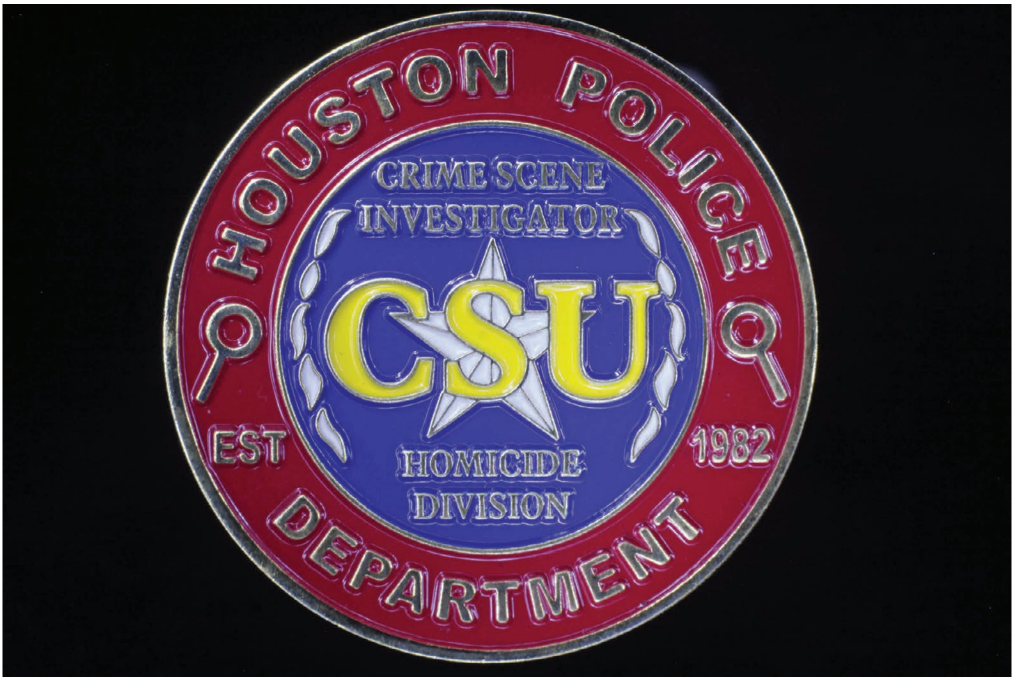

HOUSTON POLICE DEPARTMENT
CRIME SCENE INVESTIGATOR
CSU
HOMICIDE DIVISION
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Figure 5.24 (Continued) (c) A photograph of ballistic evidence and recorded at ISO 100, f/22, for 5 seconds. (d) An image of a challenge coin (jewelry) and was recorded at ISO 100, f/16, for 20 seconds.

A single-bulb LED light with a flexible head and a fiber-optic flashlight attachment for small penlight flashlights (available at tool supply stores) are outstanding devices to complete a specific type of evidentiary photograph that can provide a great deal of information to viewers. Pistols and other firearms are frequently used during criminal acts, and when recovered, the examination and photography of the barrel's interior can provide valuable information on whether the weapon had been fired or if blood and/or tissue had been drawn back into the weapon's barrel. Composing this image was done by placing the gun's barrel aimed up toward the camera's lens. Next, a small flashlight was slid into the weapon's breach or in the back end of the barrel. The light will be shined up through the barrel and provide illumination inside the barrel, while ambient light or painted light can be cast around the exterior of the weapon (Figure 5.25).

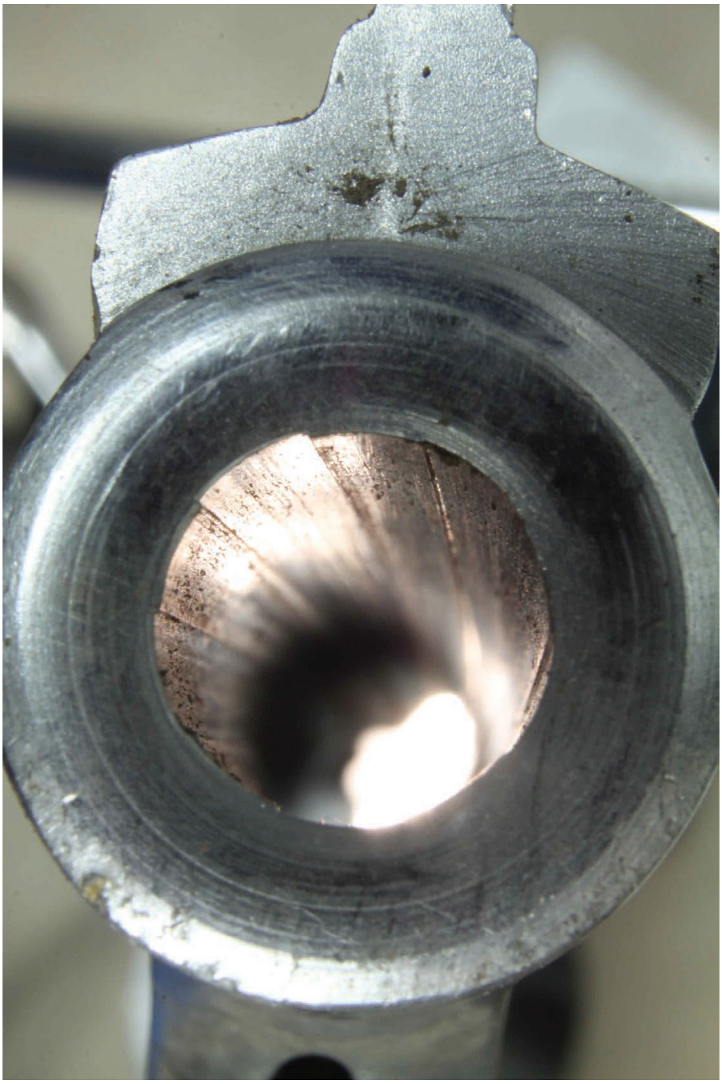


Figure 5.25 An interior of a pistol's barrel was illuminated in this figure by a single-bulb LED flashlight. The exposure values were ISO 100, f/22, for 22 seconds.

The difference between a forensic photographer and a casual photographer is the ability to take control of one's photography. Stepping out of one's comfort zone and setting the camera to manual focus and manual exposure determinations will allow the photographer to create better, more accurate evidentiary images. The next step to improving one's photography is to examine and analyze a composition and determine how and where light needs to be applied in order to record the best possible image. Slowing down the photography process, turning out the lights, and utilizing small flashlights to illuminate the evidence will allow the photographer to be more creative and apply light to specific areas of the composition that will provide the investigation with better evidentiary photographs. In conclusion, painting-with-light techniques can be applied to both large and small compositions. Painting-with-light techniques simply allows photographers the ability take control of their photography, whether the subject is an expansive crime scene or an individual green bottle blowfly.

Special Considerations When Photographing Motor Vehicles

Photographing motor vehicles can be a challenge for a number of reasons, but primarily center around the difficult lighting challenges commonly found inside vehicles, the numerous reflective surfaces found on a vehicle, and the tight quarters that evidence tends to find itself tucked into. Meeting these challenges requires some preparation and thought. A photographer must be aware of how their light is impacting a surface and how much light is being projected. Light-reflecting off a car can cause hot spots in the image, causing an underexposed image, and potentially a loss of important detail in the composition. If light is directed toward a subject, but strikes some object in the foreground, a dark shadow can develop and hide important information. And what about when a camera lens cannot physically fit into a space containing a piece of evidence? Being prepared for these challenges and others is just another part of processing a motor vehicle effectively.

Investigators must be constantly aware of their flash or other light sources when photographing vehicles. Light is everything in photography, and challenges offered by vehicles are numerous. To begin with, it bears repeating that a light's angle of incidence equals the angle of reflection (Figure 5.26). Basically, that means if light is cast straight onto reflective surfaces, the harsh light will return straight back to the camera. It is recommended to cast light on a subject from an angle away from the camera lens. Yes, this means using the camera's pop-up or built-in flash is not recommended when photographing reflective surfaces like painted surfaces, license plates, and glass. Casting the light at an angle will cause that light to bounce away from the surface at the same angle it was applied and, therefore, a properly illuminated subject is captured by the camera (Figure 5.27).

As mentioned earlier, inexpensive LED light stands can also help eliminate harsh reflections on glossy-painted vehicles and generally have a broader area of coverage than an electronic camera flash. Setting up light stands on either end of a vehicle or on either side of a specific point on the vehicle can cast well-balanced illumination into the composition and make photography much easier than trying to deal with an electronic flash and its TTL metering system (Figure 5.28). These light strips are not particularly bulky or cumbersome. As a result, they can be easily maneuvered around a vehicle during its photography and used quite efficiently inside the vehicle as well.

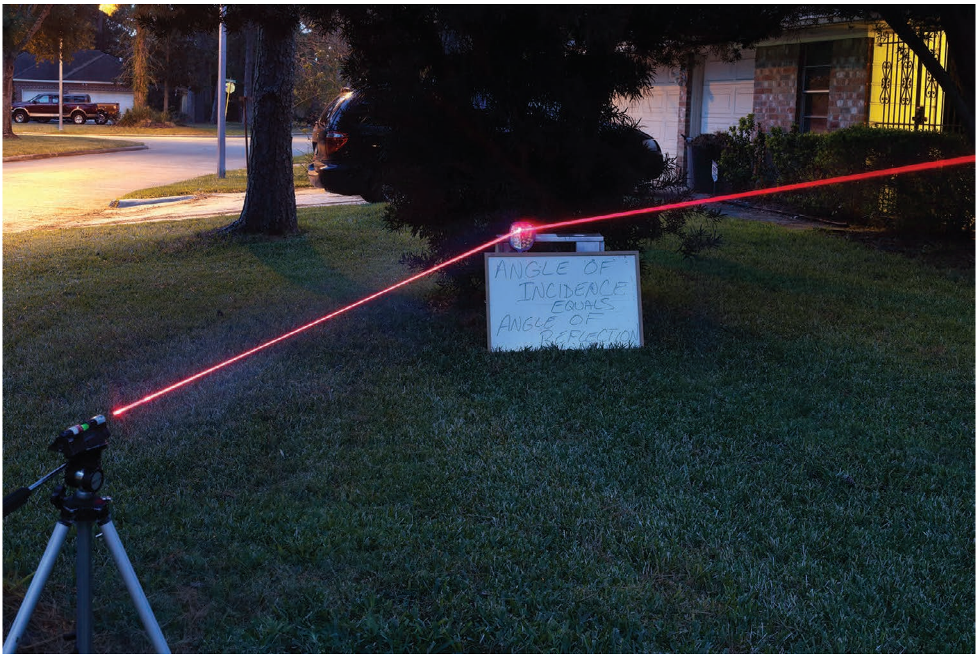


Figure 5.26 The angle of incidence equals the angle of reflection. The light from the laser beam bounces off the mirror at the same angle that it impacted the mirror. Camera flashes operate in the same fashion, and this rule should be kept in mind to help eliminate harsh reflections in one's photographs, especially when using a "Pop-Up" or "Built-In" camera flash.

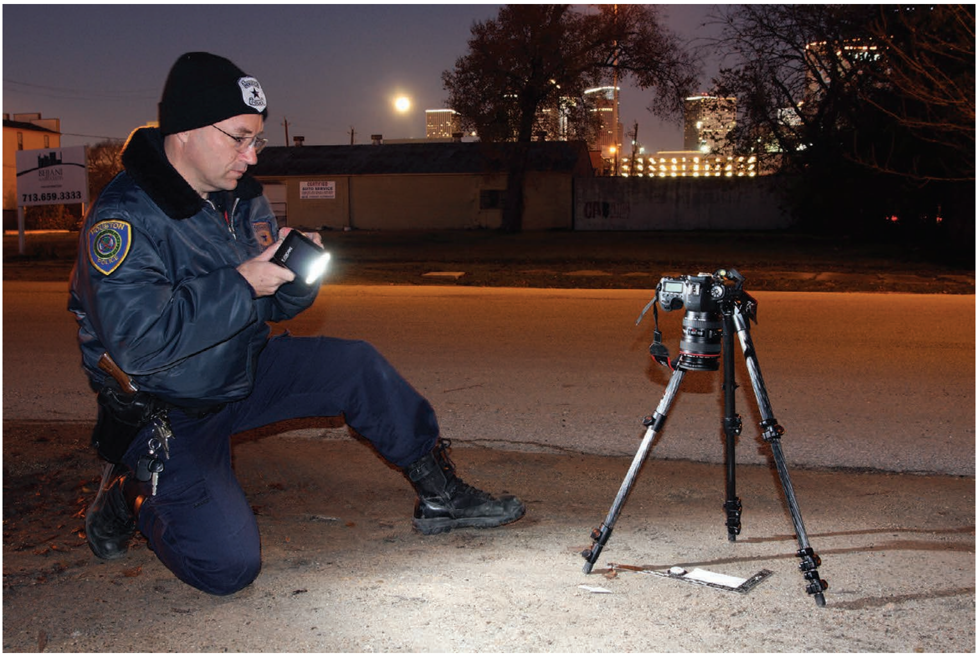


Figure 5.27 When applying flash onto a subject, it is always beneficial to cast the light from a distance rather than super-close to a subject and that light should be cast at an angle to avoid any harsh reflections.

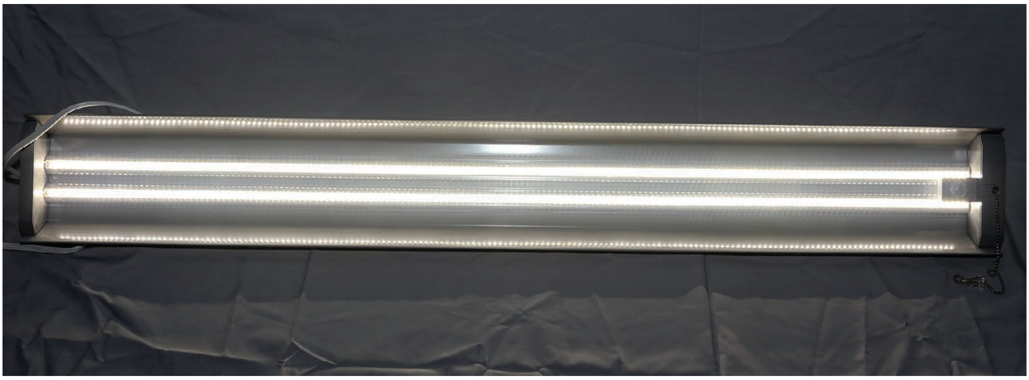


Figure 5.28 Using inexpensive LED light strips to illuminate a vehicle helps provide a more even coating of light into the composition and helps eliminate distracting reflections. These lights can be inexpensively purchased at any big-box department store or home improvement store.

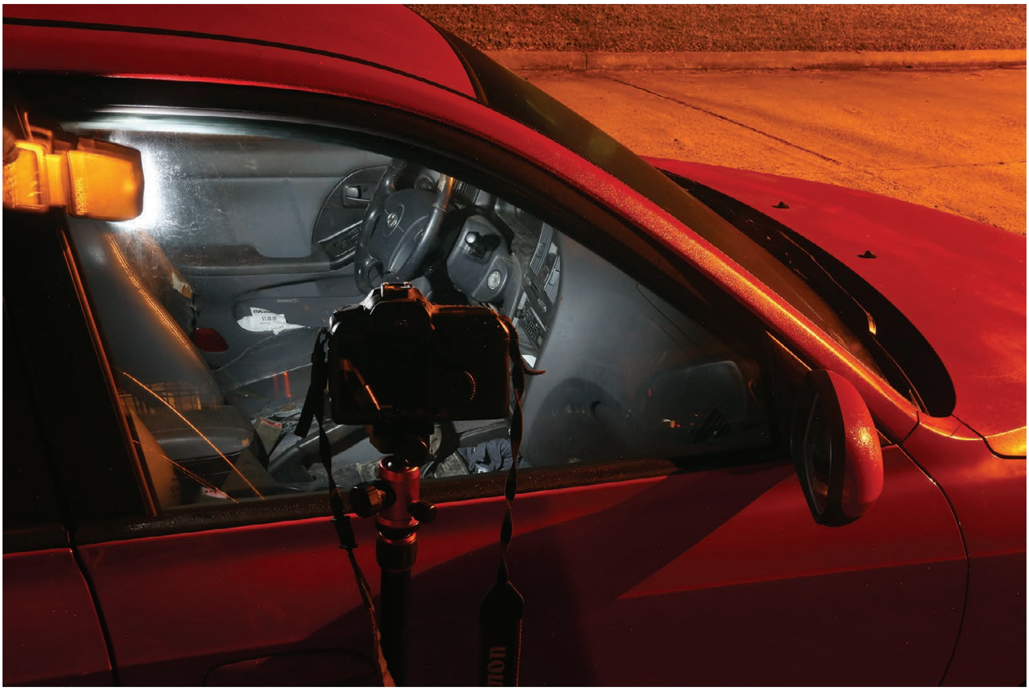


Figure 5.29 When recording an image through window glass, it is important to place the camera's lens as close to the vehicle's window as possible. More importantly, the light source needs to be away from the camera's lens and flush against the window so that no harsh reflections appear in the image.

Window glass is extremely reflective, and if the photographer is attempting to photograph through a window to see something inside the car, they should not use a flash or other light source from a distance. The light source should be cast from inside the vehicle or with the flash or light pressed up against the car's window (Figure 5.29). Of course one can open a car door to record the image, but if the investigator needs to show the placement of an object that is in plain view from the outside of the car, then one may need to cast light from outside the car. If a situation arises when the photograph needs to be recorded before access to the car's interior is possible, the photographer should hold the electronic flash and the camera lens flush against the car's window. By holding the light source and the camera lens against the window, any reflections are greatly reduced, if not completely eliminated. Another word of warning when photographing through car windows and that is to watch one's focus. Auto-focus lenses will focus on the first or closest object it sees in the viewfinder and that is generally the window and not the subject behind the window. As a result, it is recommended that the photographer manually focus the subject to ensure the composition is properly focused.

Other reflections may be caused simply by the polished surface of the vehicle and be present simply because of the ambient light in the garage. Chrome trim pieces and bumpers are an excellent example of this. If a piece of evidence, such as human blood, tissue, or a bullet strike, is found on one of these highly reflective surfaces, then it is like photographing a mirror. One needs to eliminate the distracting background. One easy way to eliminate unwanted reflections is to block out the unwanted background with white paper. If the reflection is large, one could use a sheet of appropriate-sized butcher paper or simply use a letter-sized piece of card stock. The photographer will need to cut a hole in the card stock large enough for the camera's lens to poke through and set the camera in front of the composition's subject, preferably on a tripod so that the evidence technician has more control over the photograph (Figure 5.30). With the camera securely mounted onto a tripod, the photographer

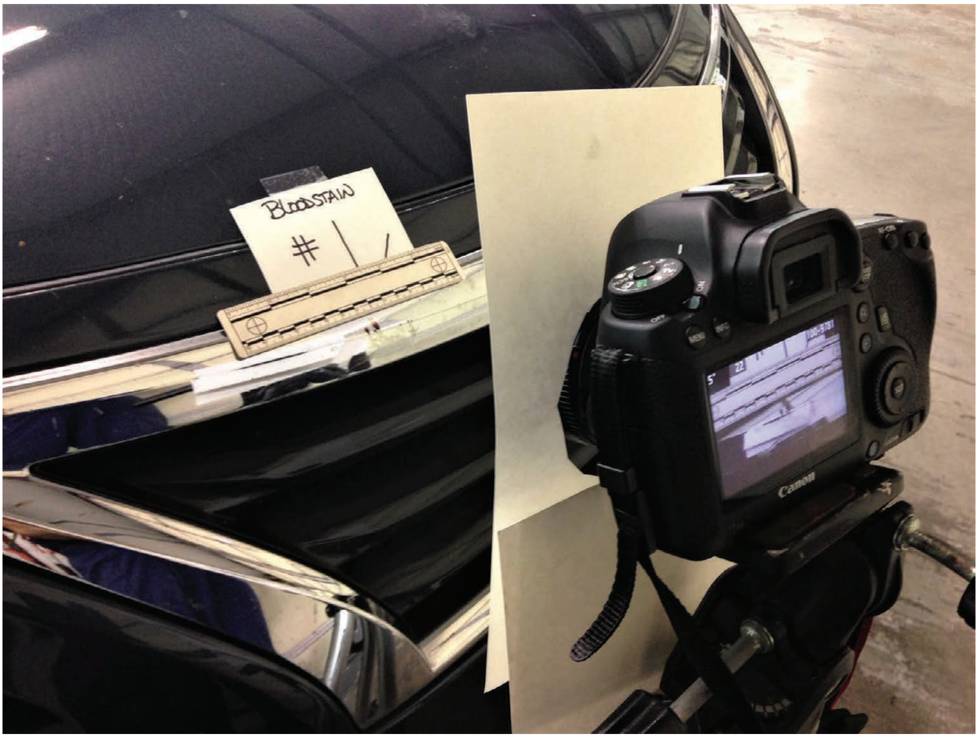


Figure 5.30 The highly reflective chrome on this vehicle possesses an important bloodstain that is going to be recovered as evidence. To eliminate distracting reflections, the white card stock was positioned around the camera's lens prior to recording the image. The card stock eliminates any unwanted reflections from appearing in the chrome trim.

can evaluate the image in their viewfinder or on the camera's image review screen and make adjustments to the paper(s) to remove all distracting reflections (Figure 5.31). Another common unwanted reflection occurs when the lights in the garage reflect off the car. This usually occurs in close focusing efforts but is still detrimental to photographic results. When

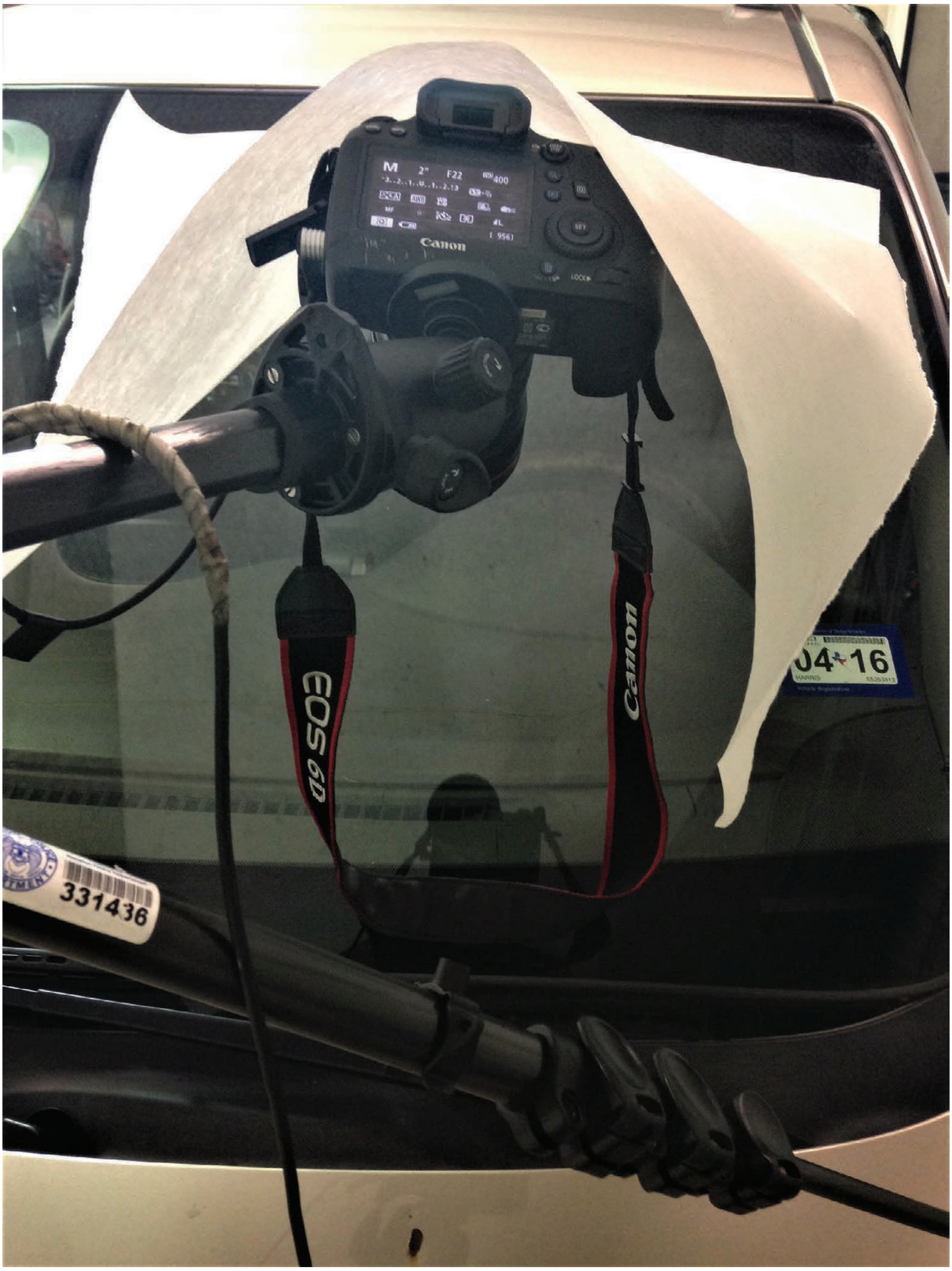


Figure 5.31 When unwanted ambient light reflections are needing to be removed from the composition, but the light cannot be turned off, creating a makeshift umbrella over the subject works ideally. In this case, butcher paper was placed atop the camera and the vehicle's windshield being photographed, thereby removing distracting reflections.

unwanted light reflections are caused, the photographer can simply place a blocker over the composition to prevent the unwanted reflections (Figure 5.32). The key to becoming a quality photographer is to look at the composition, determine the areas that are problematic, and figure out a way to solve those problems.

VIN plates found underneath the front driver's side windshield are a special kind of torture for photographers. Some VIN plates are nicely raised, and some VIN plates are two-toned for easier photography. These VIN plates are not the most difficult to photograph. However, enough VIN plates have no relief and the numbers are the same color as the plate itself, and thus, photographing them is a real challenge. In addition, because the VIN plates are behind glass, one has to deal with all the reflection issues again. Photographing VIN plates is just as difficult in darkness as it is in the light of day. The reflective glass that VIN plates rest behind is a challenge, but can be defeated by photographing the VIN plate at a slight angle. When setting the camera square over the VIN plate, poor lighting and background reflections may develop in the composition. Photographing the VIN plate at an angle does produce another problem and that is focus. The depth of field in close focusing situations is extremely narrow. Consequently, photographers should choose a small aperture (larger f/number) in order to enlarge the composition's depth of field. In addition, remember that the depth of field or focus is approximately 1/3rd to the foreground and 2/3rd to the rear. A VIN is 17 digits long; therefore, the photographer's focus point should be approximately the 6th or 7th digit closest to the camera lens when photographing down the length of a VIN plate [Figure 5.33(a)]. To ensure the VIN's composition is in focus throughout the 17 digits, remember to

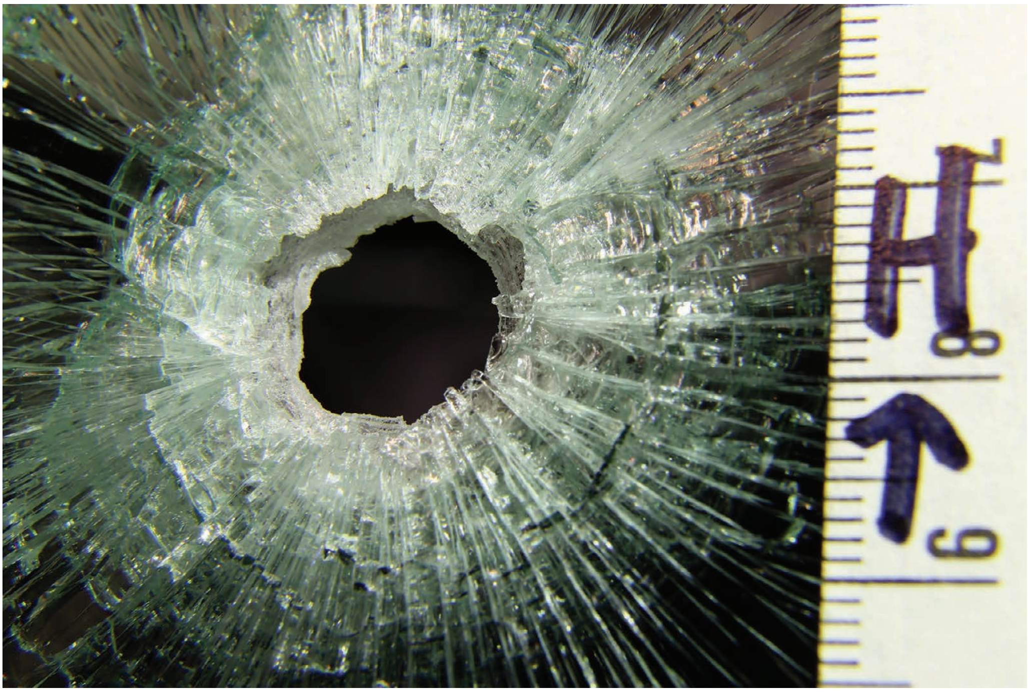
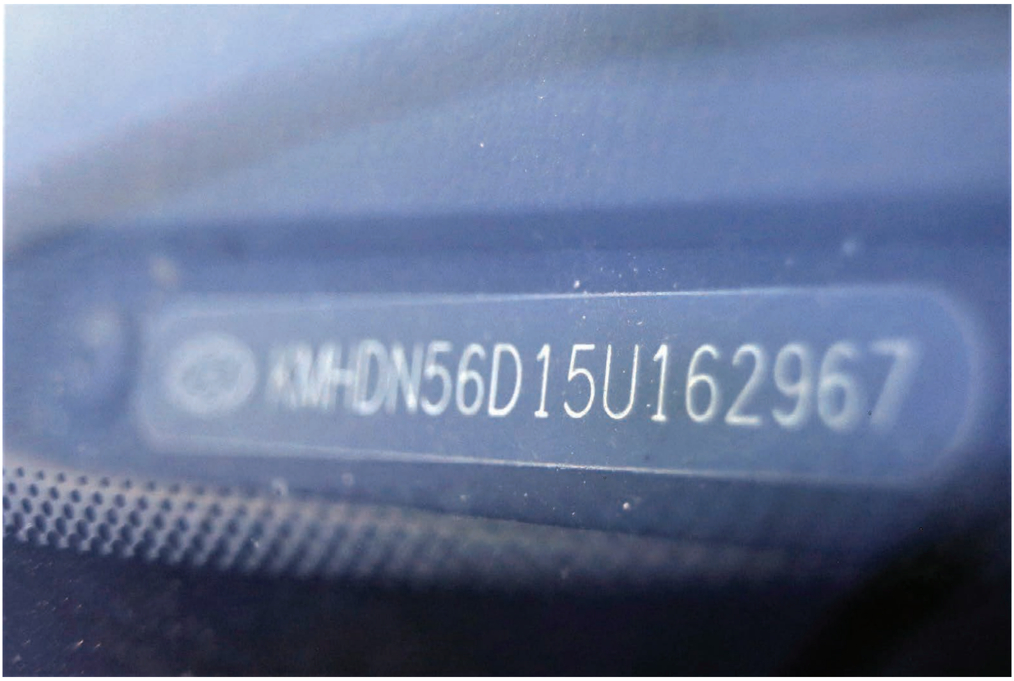


Figure 5.32 The resulting photograph of a bullet strike on a highly reflective windshield was improved by covering the area above the composition with a large piece of butcher paper, thereby eliminating distracting reflections.

(a)



(b)

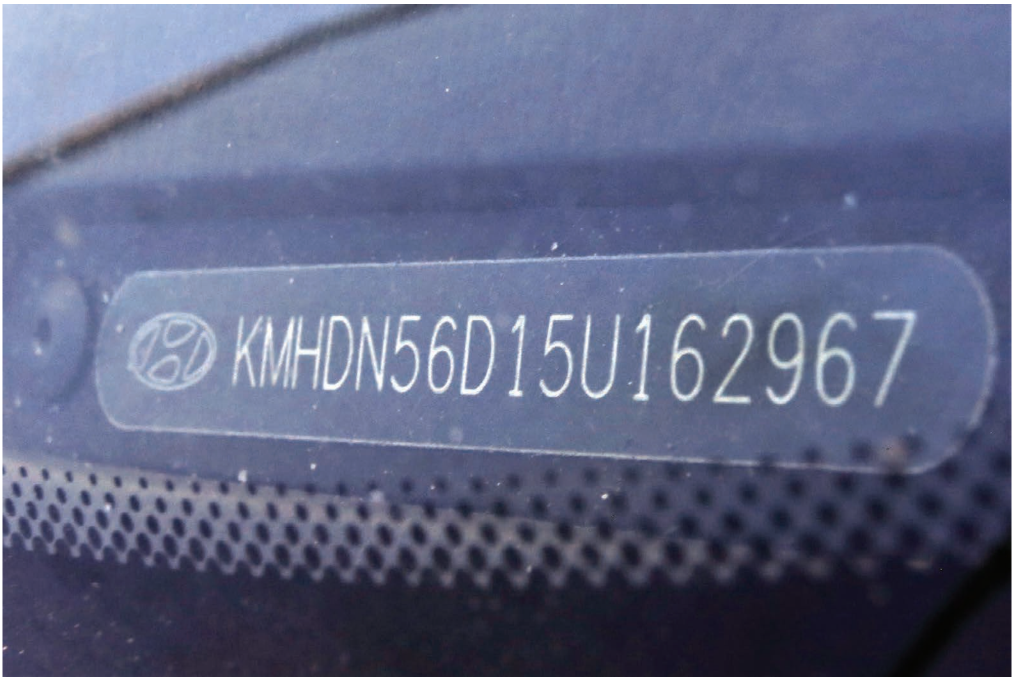


Figure 5.33 Photographing vehicle identification number (VIN) plates can be a challenge because of reflections on the windshield and because of a shallow depth of field. These VIN plates were photographed with the focus point on the 7th digit closest to the camera lens. (a) The image was recorded with a large aperture of 4.0, which is a common aperture when a photographer sets their camera to "Program Mode." Notice how both ends of the VIN plate are out of focus. (b) The image was recorded with an aperture of f/16 to expand the depth of field to cover the entire length of the VIN plate.

choose as small an aperture as possible [Figure 5.33(b)]. Another possible solution is to cast light on the VIN plate by placing a light obliquely to the VIN plate on the inside of the vehicle. This can help define the digits in the photograph if they are slightly raised off the plate (Figure 5.34). Proper focus can still be a problem when photographing from this raised position because of the auto focus feature. Be sure to manually focus when shooting through glass and focus on the composition's subject (VIN plate). If the VIN plate is missing or damaged, do not forget to look for and photograph the driver's door frame VIN plate or one of the other VINs found on the vehicle.

Photographing in the tight confines of a motor vehicle can present its own set of challenges, such as casting distracting shadows and the difficulty of getting light onto the subject. A common location for contraband is under the driver's or front passengers' seats. Weapons, narcotics, and just about anything are commonly stashed under the seats by suspects attempting to conceal their contraband. It is always recommended to photograph all evidence in the condition or location where it was originally found. These locations may be difficult to get a hand into, much less the camera and a light source. As a result, vehicle examiners must be contortionists from time to time. Trying to get light into the tight confines underneath a car seat may preclude the use of an off-the-camera electronic flash. The pop-up or built-in flash might be advantageous in these tight quarters, if the photographer is lucky enough to get the right camera orientation to the subject. More often, a constant light source is a better choice when working in such tight quarters (Figure 5.35). Flashlights or LED light strips are a good choice for a constant light source. Sometimes these lights are sold with diffusers that can be used to spread the light out more evenly across a subject. A makeshift diffuser can be made out of a white tissue or a handkerchief. Place one or the other over the light source and it can help diffuse the light, take away any harsh hot spots, and spread the light out across the composition. These techniques can be used elsewhere on the vehicle as well, like the trunk and engine spaces.

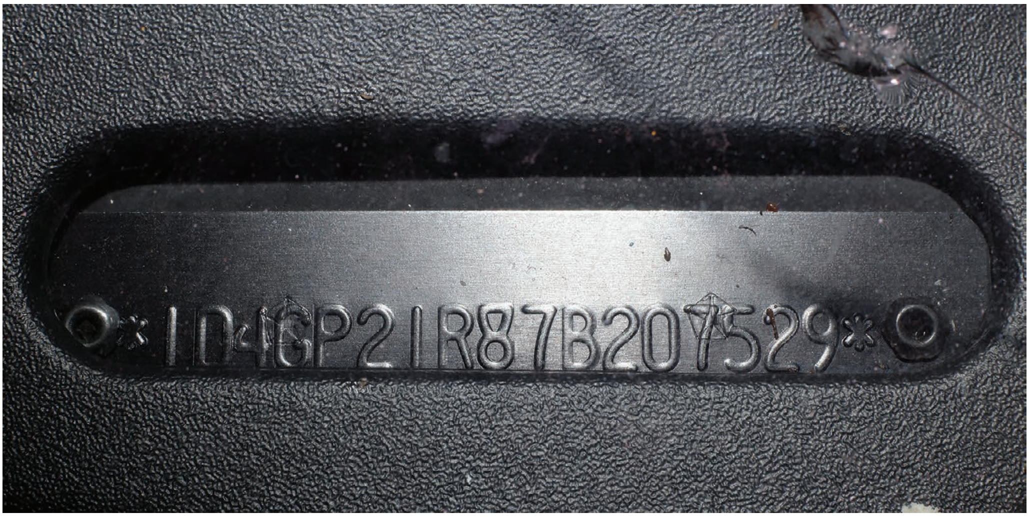


Figure 5.34 Casting light obliquely across a difficult vehicle identification number (VIN) plate that happens to have raised letters can help define the VIN.

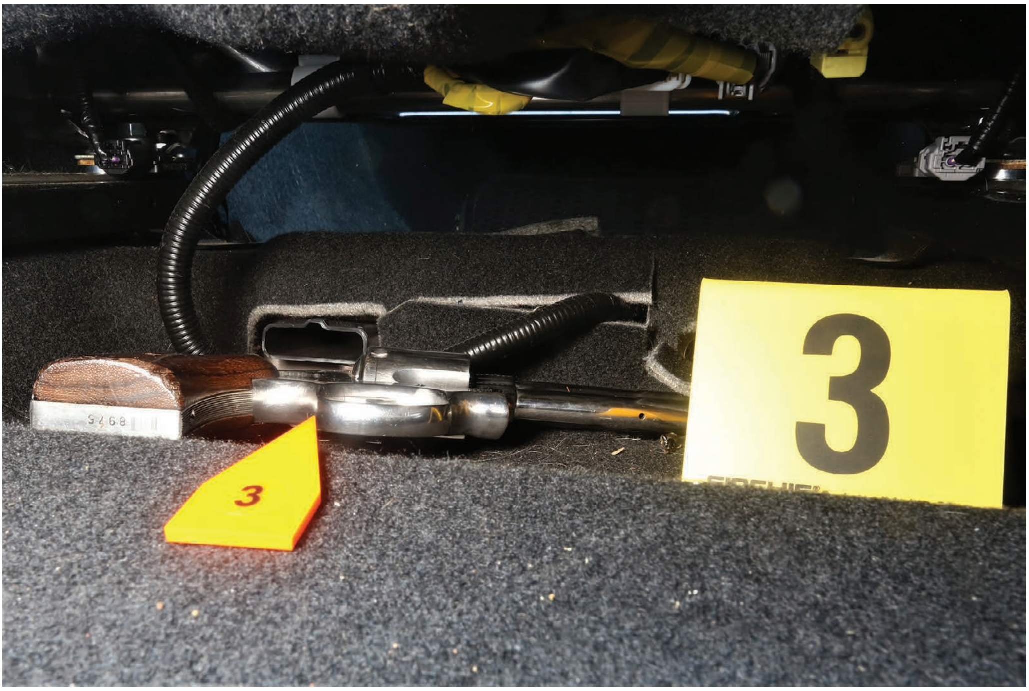


Figure 5.35 Oftentimes an investigator will have to manipulate their body, as well as their camera equipment into tight-fitting compartments. This pistol was found underneath a car seat and was photographed with a diffused external flash that was removed from the camera's body and placed directly next to the camera's lens in order to cast light into the narrow cavern. On occasion, a flash will not be able to cast light into even smaller spaces, and in those cases, the investigator may resort to using a flashlight and "painting" the subject area with light.

Conclusion

Understanding how a camera works, how light is metered, and how cameras focus are all important skills for crime scene investigators to master. These skills help create valuable pieces of evidence that can be presented in order to tell a story to a jury. Reading of the camera's user manual is often a skipped step by experienced photographers. However, knowing how the basics of aperture, shutter speed, and ISO values combine to create an exposure does not do any good if the photographer does not know how to set those values on the camera. Composition is also an important skill to learn. Looking at a potential composition, identifying the potential problems, and developing a plan to overcome them is a wonderful skill to possess. Some photographers may claim that they can fix photo errors with post-capture editing software like Photoshop. However, post-capture software cannot fix poor focus, motion-damaged pictures, or subjects that are not even in the field of view. Photoshop-type programs are wonderful, but they are not the solution to every problem. In addition, edited photographs may be more easily challenged in court and could be excluded from the trial. When a photographer becomes comfortable with the basic skills of photographic exposures and documenting a vehicle, they can move on to more advanced techniques involving alternate light sources and chemiluminescent chemicals.

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Review Questions: The Photographic Documentation of Vehicles

1. Which of the following can influence the quality of a close-focused image?
   a. Lighting
   b. Depth of field
   c. Perspective
   d. All of the above
2. What can substitute for a formal photo log in an examination quality photograph?
   a. Scale
   b. Subject identification tag
   c. Date and time stamp
   d. All of the above
3. What statement is most true when photographing scales?
   a. Scales should be aligned with the viewfinder's borders or frame
   b. Scales should be included in all photographs
   c. Scales should only be black or white in color
   d. Scales are not necessary in evidentiary photographs
4. What is the guiding principle of painting with light?
   a. Light is objective
   b. Oblique application of light
   c. Guide number = aperture × distance
   d. Light is additive
5. Which of the following is NOT one of the camera settings that should be checked prior to the photographic documentation of a vehicle?
   a. ISO settings
   b. Aperture settings
   c. Metadata settings
   d. Image quality settings

6. What type of lighting generally has the best white balance?
    a. Incandescent
    b. Fluorescent
    c. Mercury vapor
    d. LED
7. What is the rule of thumb regarding how fast a shutter speed should be in relation to the lens?
    a. One over the lens' focal length
    b. Two times the lens' aperture
    c. Lens' focal length divided by 4
    d. 1000 divided by the lens' focal length
8. How can a photographer help stabilize a camera to keep the photograph sharp?
    a. Monopod
    b. Faster shutter speeds
    c. Use a lens with an image stabilization feature
    d. All of the above
9. What is the photography word or phrase that basically means taking multiple exposures of the same composition, but with different camera settings and/or perspectives?
    a. Inverse square law
    b. Rule of thumb
    c. Bracketing
    d. Value of completeness
10. What is the average reflectivity of nature and what cameras are trying to achieve in evaluating compositions for exposure?
    a. 18% gray
    b. 24% gray
    c. 33% gray
    d. 50% gray
11. Which recording media has the most exposure latitude in photography?
    a. Color slide film
    b. JPG saved images
    c. Color print film
    d. All of the above have equal exposure latitude
12. How is a camera's depth of field generally divided up?
    a. 1/3 to the rear, 2/3 to the front
    b. 50/50 rear and front
    c. 1/3 to the front, 2/3 to the rear
    d. Depends on the focal length of the lens
13. Which of the following exposure settings affects an image's depth of field?
    a. ISO value
    b. Aperture
    c. Shutter speed
    d. Color balance

14. Which type of crime scene photographs are designed to illustrate and document the relationship between different pieces of evidence and the crime scene?
    a. Overall photographs
    b. Midrange photographs
    c. Close-up photographs
    d. Examination quality photographs
15. What does a camera's flash meter evaluate during a flash exposure?
    a. The object closest in the viewfinder
    b. The center of the viewfinder
    c. The camera's focus point
    d. 2/3 of the focal length
16. What is defined as the loss of light is inversely proportional to the square of the distance from the source?
    a. TTL metering
    b. Rule of thumb
    c. Bracketing
    d. Inverse square law
17. Regarding the travel of light, the angle of ______(1)_______ equals the angle of _______(2)_________.
    a. (1) inference (2) evaluation
    b. (1) incidence (2) reflection
    c. (1) occurrence (2) origination
    d. (1) contrast (2) inversion
18. What do auto-focus lenses seek to focus on?
    a. The subject of the composition
    b. The brightest object in the viewfinder
    c. The closest object in the viewfinder
    d. The sharpest point of contrast
19. Which ISO value provides the sharpest image, with the most saturated color?
    a. ISO 100
    b. ISO 200
    c. ISO 800
    d. ISO 1600
20. Which aperture provides the greatest depth of field?
    a. f/4.0
    b. f/8.0
    c. f/11.0
    d. f/22.0

Advanced Photography Techniques of Challenging Subjects

6

Once a crime scene investigator becomes comfortable with their camera and photography equipment, they are better equipped to move on toward more difficult photographic tasks. Recording photographic images in the controlled lighting of a garage or under sunlight is not necessarily a difficult task. Photographing unseen evidence, using chemiluminescent chemicals or ultraviolet and/or infrared light to find hidden bloodstains can be a challenge, but something easily accomplished with photographic knowledge, experience, and practice. Photography also involves planning for the final desired product. Visualizing what the final picture is expected look like and then examining the composition and determining a way to reach that goal is what a true photographer is capable of doing. Juries expect the criminal investigators to perform magic like they see in crime dramas depicted in Hollywood-produced television shows. Advanced photography skills presented in this chapter can be utilized by photographers to record some awe-inspiring photographs that present evidence in a creative manner. Photographic challenges also offer the investigator the opportunity to demonstrate their professionalism and commitment to conducting the most thorough examination of a crime scene or a crime-related vehicle.

Photographing Luminol or Bluestar and Other Chemiluminescent Reactions

The photography of luminol, Bluestar, or other photoluminescent chemicals has been a challenge to crime scene photographers for a long time. However, with the advent of digital photography, the success rate is much higher than it was in the days of film. This is mainly attributed to the ability to see results and make adjustments in exposure settings to improve the final result. Back in the days of film, one could only bracket their exposures in the hope of getting a positive result. As the chemiluminescent chemicals react with the iron found in blood, it gives off a blue-colored fluorescence. The fluorescence is not typically bright enough to be visible in anything except low-light environments. However, the photography of luminol and Bluestar is not a complicated endeavor and merely requires a little thought and patience on the part of the photographer.

There have been a number of methods suggested over the years on how best to photograph these chemical reactions. Everything from recording multiple images and combining the images in an advanced post-capture editing manipulation to using high-definition resolution (HDR) photography methods. However, there is really no need for any hi-tech technique or the use of an image-enhancement program in order to document the latent bloodstains patterns found on a crime scene or a vehicle (Figure 6.1). The basic principles of exposure and light are all that is needed to record outstanding quality photographs, even in near-blackout conditions.

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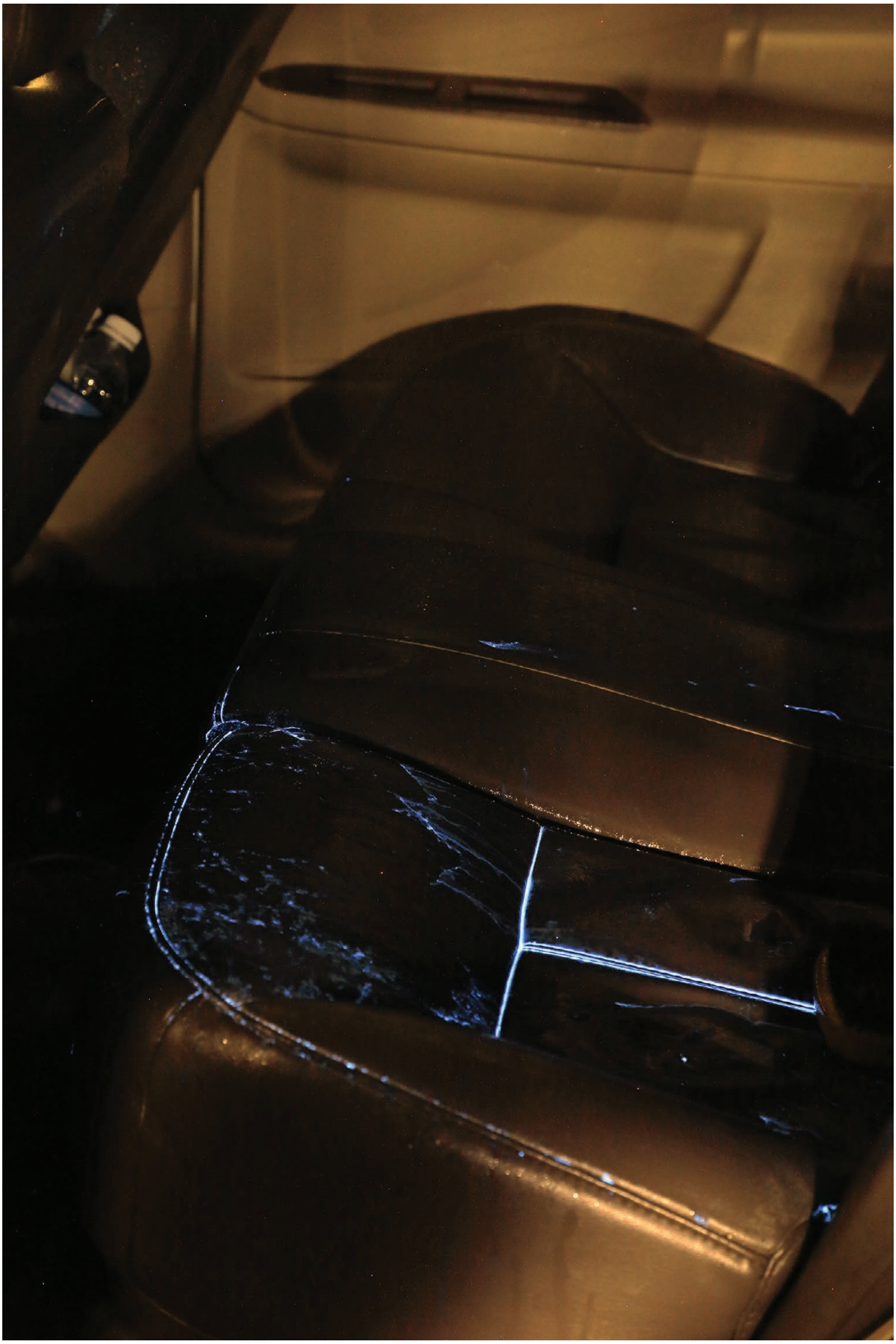

Figure 6.1 Camera settings: ISO 400, f/8, for 2 minutes. The image was recorded in complete darkness, which allowed the luminol's fluorescence to burn into the image over 2-minute exposure. Supplemental light was added with a flashlight bounced off the roof of the vehicle for several seconds.

Besides the need for chemiluminescent chemicals, the photographer will need to gather their equipment prior to applying any chemicals to a vehicle. First and foremost, the photographer needs a good-quality camera. A single lens reflex (SLR) camera is recommended for this type of photography. The inexpensive "point and shoot" cameras are not always capable of recording exposures long enough to record a chemiluminescent reaction. In order to take the longer exposures, the camera will have to be mounted on a sturdy tripod and a cable release attached to the camera. A "cable release" allows the photographer to trip and hold the shutter open remotely. The photographer should also have a flashlight or an external flash unit in order to add supplemental light to the composition so that the reaction can be placed into context of the scene.

Crime scene investigators will have their own personal preferences as to whether they prefer to work with luminol or Bluestar. Because Bluestar requires a greater amount of blood to cause a reaction, the reaction is naturally brighter than luminol and easier to detect in environments that are not completely dark. Luminol reactions require that the location be as dark as possible. The choice between luminol and Bluestar is up to the individual investigator, but the photography of either chemical's reaction is largely the same. As a result, when the author refers to a "luminol reaction," the reader should be aware that the concept under discussion applies to the chemiluminescent reactions of both luminol and Bluestar.

Photographers can record the chemiluminescent image with any camera capable of "bulb" exposures, but the versatility provided by the SLR camera makes it a better choice for the recording of these chemical reactions. Certainly, if one only possesses a "point and shoot" style of camera, adjustments can be made to the exposure values in order to record a luminol reaction. However, the image quality may suffer, and the clarity of the image may not give the viewer exactly what had been detected inside or on the vehicle being examined. The photographer should also possess a cable release or a remote capture device for the camera. Timed exposures that may last 30 seconds to 4 minutes or longer, and a cable release will be necessary to complete such photographs. A cable release allows the camera's shutter to remain open without the photographer having to hold the shutter-release button down during the lengthy exposure. Furthermore, to record such long exposures, the camera will need to be stabilized upon a tripod. The tripod should be a sturdy or heavier tripod to prevent any possible camera shake. Lightweight and plastic tripods tend to tip over when accidently bumped. The sound of an expensive SLR camera hitting a concrete floor is not something anyone wants to hear. Therefore, a durable metal tripod is recommended for the process. The tripod and camera should be set up and in place before any chemical application is made. The final tool necessary for recording a luminol reaction will be for some sort of secondary or supplemental light source. An external flash or even a flashlight is ideal. Because of the darkened conditions needed for the human eye to see the chemiluminescent reaction, the camera may not be able to record the environment or context in which the reaction was found. As will be discussed later, additional light can be added to the photographic exposure to provide scene context to the photograph.

Returning to basic photography skills, understanding the "Exposure Triangle" will make the photographing of chemical reactions a much easier proposition. As a reminder, the three variables for any exposure evaluation are ISO value (film speed), aperture, and shutter speed. Pretty much everything in photography is a give and take process. Therefore, a photographer needs to evaluate the various exposure values and decide what is desirable and acceptable for each photograph. To begin with, the ISO value controls how sensitive the camera (imaging chip or film) is to light. An ISO value of 100 requires more light than an ISO value of 1600. However, the color and sharpness of an ISO 100 image will generally be better than one recorded at ISO 1600. Many photographers find that an ISO value of 400 is a good compromise when recording luminol reactions. However, nothing is written in stone as far as an ISO value, and as digital cameras continue to improve, one may find that the quality of images recorded at higher ISO values is perfectly acceptable. This is especially true with full-frame imaging sensors. Practice and experience with one's own photographic equipment is extremely valuable.

The next exposure variable needing consideration is the aperture or f/number. Larger apertures (small f/numbers) allow more light into the camera but can create a shallow depth of field. Smaller apertures (larger f/numbers) reduce the amount of light coming into the camera but increase an image's depth of field. The photographer's choice in apertures is another subjective selection. However, if the photographer does not have a specific reason for one aperture choice over another, an aperture selection of f/8 is a good compromise. An f/8 aperture typically falls in the middle of most lenses' range of apertures and is a good compromise between the light gathering ability of the lens and the composition's depth of field. Furthermore, an aperture of f/8 is likely to be close to the camera lens's "sweet spot," which is simply the aperture that provides the best corner to corner sharpness for any recorded image. In the end, the photographer should choose an aperture for a particular reason and not let the camera dictate what the aperture should be. Most cameras, especially in low-light conditions, will auto-select the largest aperture available, thereby reducing an image depth of field or thereby limiting what is in focus. That could have detrimental results when trying to identify the location of a bloodstain reaction.

The final exposure variable is the shutter speed. The shutter speed is the most versatile of all the exposure values and the one that should be used to make the majority of any exposure adjustments in a luminol composition. The ISO value and aperture value should be chosen for a specific reason or a purpose (image sharpness and depth of field). The time value or shutter speed can be altered or changed to balance the exposure for the chosen ISO and aperture selections. Of course, there is always a trade-off in any photographic composition and exposure decisions. A shorter exposure is more time efficient and is less likely to result in the development of "noise" in a digital image. Noise is the development of individual blown pixels throughout the image, creating an unwanted distortion of the recorded image. Longer exposures require a little more patience and may result in the addition of "noise" to a composition. Many cameras have built-in noise-reduction filters that can be switched on to improve the captured image. Full-frame digital sensors are well known for creating very-low noise images, even with images lasting several minutes in length. Although good luminol and Bluestar compositions can be recorded over a few seconds, outstanding images can be recorded by allowing the image to be created over a few minutes instead of a few seconds.

To begin with, documenting crime scenes and vehicles for evidence is not simply a matter of a recording a few random photographs. In addition, even with a quality photographic documentation of a vehicle, the investigator is not alleviated from taking notes, measurements, and documenting their efforts in the processing efforts. Furthermore, in order to ensure that the task of fully documenting the vehicle and prior to being processed with chemicals, a full set of photographs of the vehicle and the area where blood is expected to be found should be recorded. Once these "in situ" and establishing photographs have been captured, then the photographer can begin the chemical processing of the vehicle.

The crime scene investigator should gather up all their equipment, including the camera gear and chemicals. The investigator should have some general idea as to where they are searching for latent bloodstains. The suspected bloodstained area should be photographed prior to the first application of chemicals. However, some vehicle searches might be more extensive, or the location of potential blood is completely unknown. As a result, one may be required to complete an initial search using the chemicals first and then the area of reaction photographed while adding a second application of chemicals to the surface(s). Either way, the task of photographing the reaction is largely the same.

To begin the photographic process, the photographer should firmly secure the camera to the tripod and compose the image within the viewfinder. A natural light photograph can be focused and recorded simply for the sake of thoroughness. At this point, the autofocus feature on the camera should be turned off. Once the lights are turned off (if not already), the camera will not attempt to refocus itself in the dark with the autofocus feature switched off. The next step in the process is to set the first two exposure variables: ISO value and aperture. Unless the photographer has a specific reason for anything else, an ISO value of 400 and an aperture of f/8 is an excellent compromise for a good-quality image, light-gathering ability, and a respectable depth of field. The final exposure variable is the length of time that the exposure will last.

The next step is trying to determine the length of an exposure. Assuming the luminol is mixed and ready to go, the investigator must turn off the lights or otherwise eliminate the scene's ambient lighting. The darker the environment, the easier it will be to observe the reaction and, believe it or not, record the image. If one is working in the daytime and lighting cannot be controlled, then the photographer may simply have to wait until the sun goes down. Whether the investigator is using luminol or Bluestar, the darker the area can be made, then the easier the composition will be to record (Figure 6.2). With the light removed from the composition as best able, then the length of the exposure becomes less important because there is less risk of overexposing the composition. Furthermore, the amount of light added to the composition in order to put the chemical reaction into context is completely decided by the photographer. If ambient light is still visible at the crime scene, the photographer may be limited in the exposure's length so that the image is not overexposed.

With the introduction of digital imaging, luminol photography has been made so much easier. Before applying chemicals to the scene, the photographer can fine-tune their exposure and test to see how much supplemental light will be necessary to record a valuable image. To begin with, the photographer may not want a "properly" exposed image, because fully illuminating the composition is likely going to compete with and eliminate the visibility of any chemical reaction, especially if the reaction is weak. Therefore, slightly underexposing the image is going to provide a good balance between recording the reaction and the environment in which it is found. If the reaction is weak, a two-stop underexposure is a good starting point. If the reaction is stronger, a one-stop underexposure of the scene should result in a good quality image (Figure 6.3).

If the photographer was unable to eliminate all the ambient light, then he or she will need to meter the ambient light. By using the camera's light meter, the amount of time needed to record a proper image can be determined by setting the already chosen ISO value (ISO 400) and aperture (f/8), and then letting the camera tell the photographer how long the exposure should be. However, remember that the exposure may need to be underexposed a little in order to see the chemical reaction. The photographer can record the

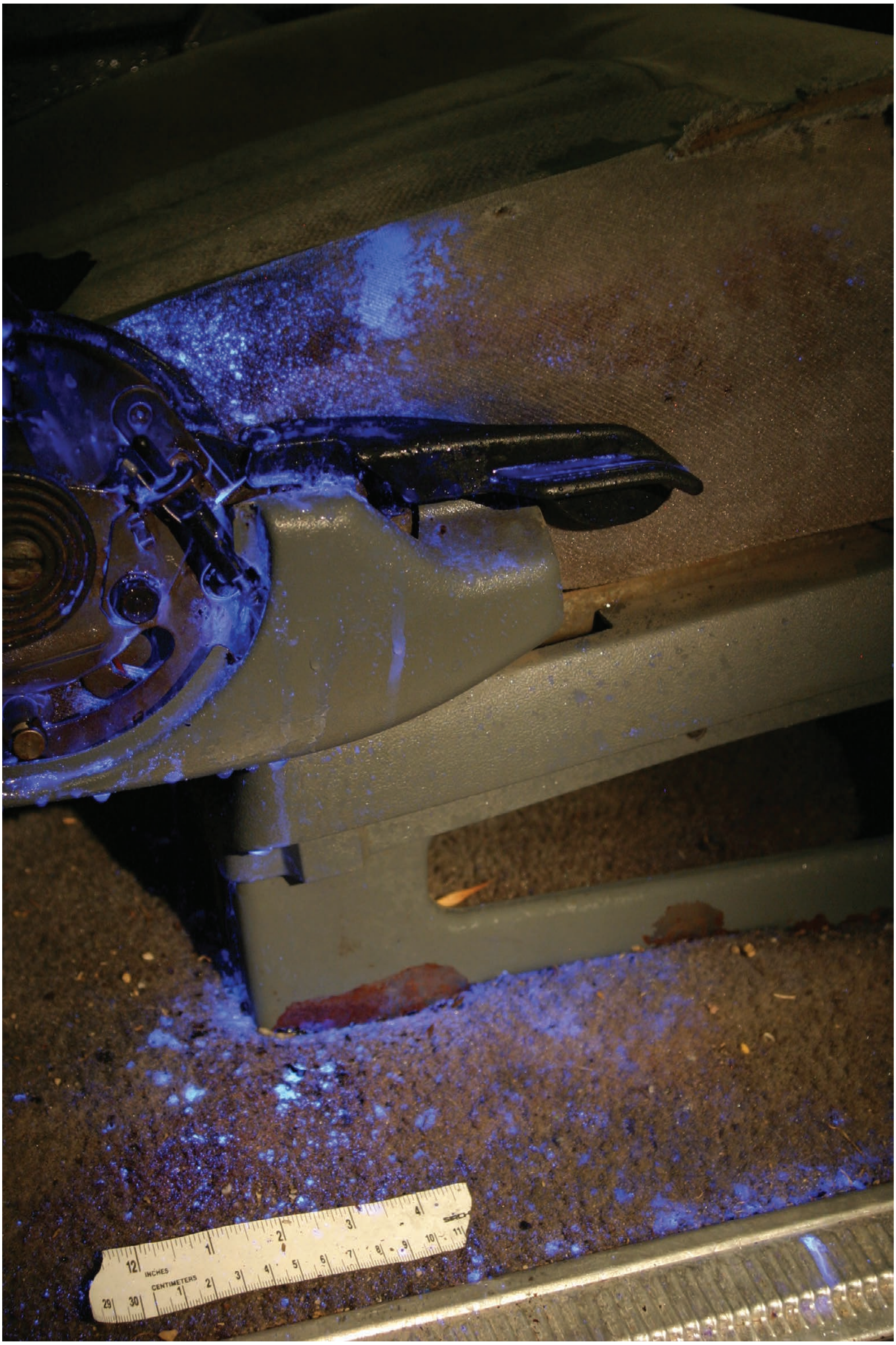

Figure 6.2 Settings: ISO 400, f/4.5, for 30 seconds. The image was recorded in complete darkness, and supplemental light was added with an electronic flash bounced off the ceiling and set to a one-stop underexposure.

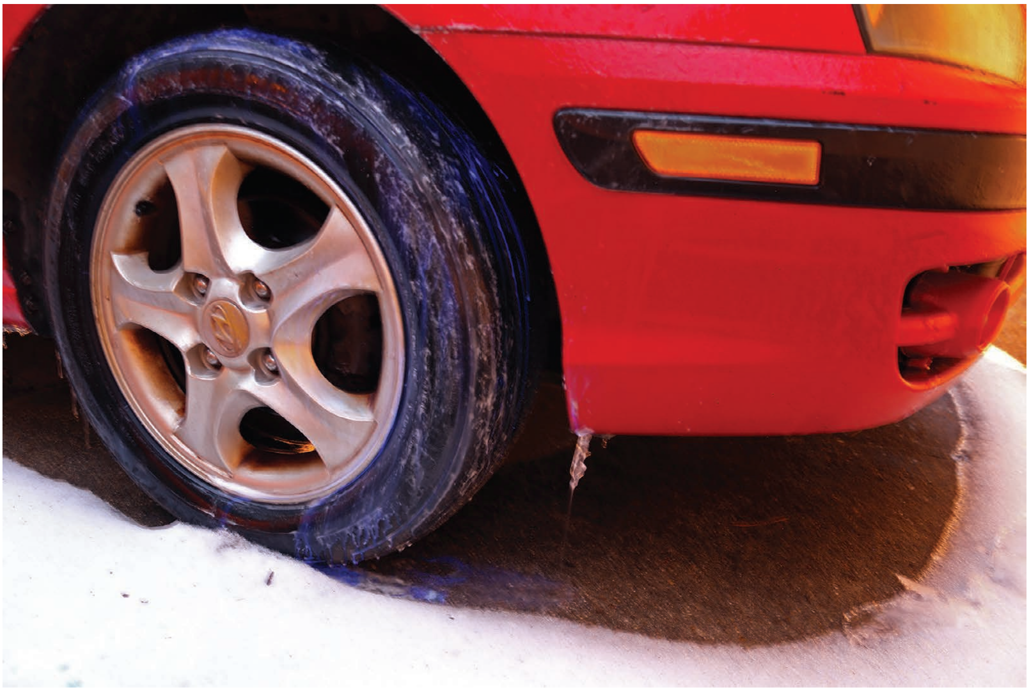

Figure 6.3 Settings: ISO 400, f/5.6, for 30 seconds. The image was captured with a fairly well-illuminated environment. The ambient light was provided by a nearby street light and the camera's light meter accurately metered the vehicle's natural lighting, while the Bluestar fluoresced in the wheel well's shadow.

"underexposed" image prior to the chemical processing of the vehicle and evaluate the exposure for possible adjustments. If the investigator was able to eliminate all the ambient light, then the exposure is a little easier. The supplemental light can be added with an electronic flash or flashlight. An off-the-camera electronic flash will have its own exposure compensation setting outside of the camera's exposure evaluation, and it should be set to underexpose the composition by one to two stops of light, depending on the amount of ambient light. It is also beneficial if the flash is bounced off a nearby surface, because aiming the flash directly onto the surface containing the latent bloodstains could unintentionally washout the chemical reaction (Figure 6.4). Another way to add supplemental light to the scene is with a flashlight. Casting a typical police-style flashlight off a nearby surface for 2 to 3 seconds will likely result in a quality, slightly underexposed image. The flashlight can be painted or moved across the vehicle's interior roof or car doors in order to provide a more even coating of light to the car's seats or floorboards. How long to shine the flashlight across the subject is based on the intensity of the light, the distance the light has to travel, and the depth of the vehicle or the subject matter. Once again, taking a practice exposure prior to the addition of chemicals to one's scene is a good recommendation. The image can be reviewed and the exposure fine-tuned for the actual luminol or Bluestar recording.

If ambient light is present and impacting the vehicle, then the length of the exposure will be limited so that the chemical reaction will not be washed out. However, if the investigator is able to remove all or at least the majority of ambient light from the composition,

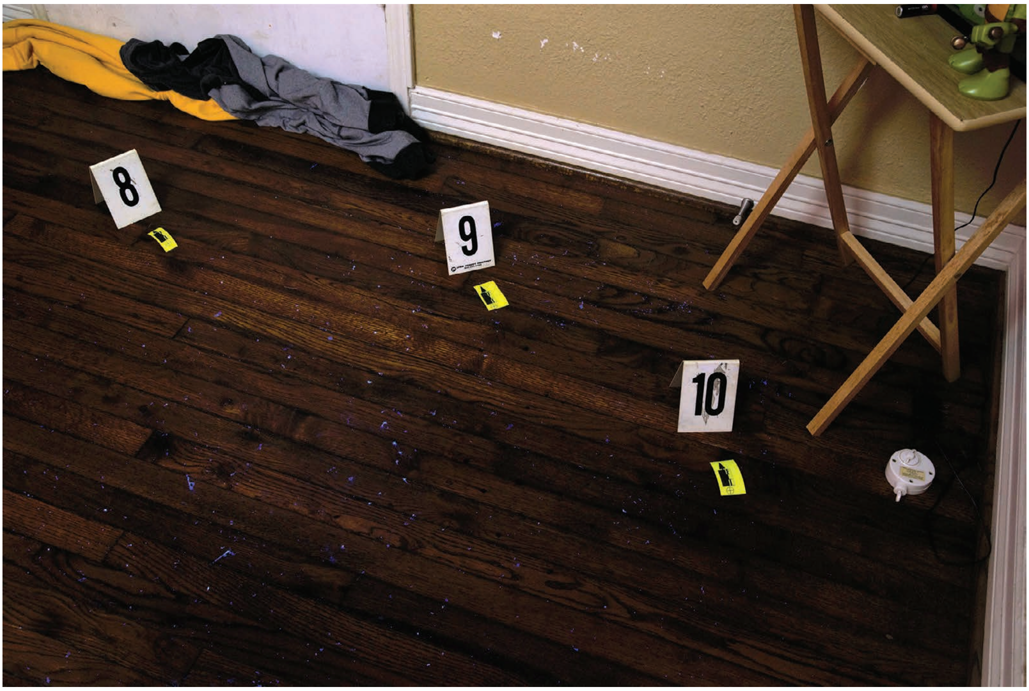

Figure 6.4 Settings: ISO 400, f/8, for 352 seconds. The image was recorded in a darkened room for just 6 minutes, which allowed the faint Bluestar reaction to burn into the image. To allow the context of the stains to become visible, supplemental light was added with a flash bounced off the ceiling and set to a one-stop underexposure.

then the photographer can simply let the chemical reaction continue to burn into the image for several minutes and not be worried about overexposing the overall image. Regarding photographic imaging, "Light is Additive." As the luminol or Bluestar chemicals react with the latent bloodstains, the reaction, even a weak one, can be allowed to continue for several minutes, but weak reactions may be compromised by too much ambient light. As a result, investigators should do their best to reduce or eliminate as much ambient light as possible. If necessary, supplemental light can always be added to the exposure later. It does not matter whether the supplemental light is added at the beginning, middle, or end of the exposure. How long to allow the chemical reaction to occur and to photograph depends on the intensity of the reaction. A Bluestar reaction may take up to 1 minute to capture a quality image, while a faint luminol reaction may take as long as 3 or 4 minutes. Certainly, one can increase the ISO value and/or open up the aperture to take quicker exposures. However, just because the exposure is captured in a shorter amount of time does not mean that the image has better quality. Consequently, a little patience goes a long way and photographers that allow for longer exposures, smaller apertures, and lower ISO values will be rewarded with sharp focused and more vibrant images (Figure 6.5). Once again, digital imaging has a tremendous advantage over film photography, in that the recorded image can be reviewed and the length of the exposure or amount of supplemental light can be adjusted to create a better final product. It should not take more than two to three attempts at obtaining a quality photographic image.

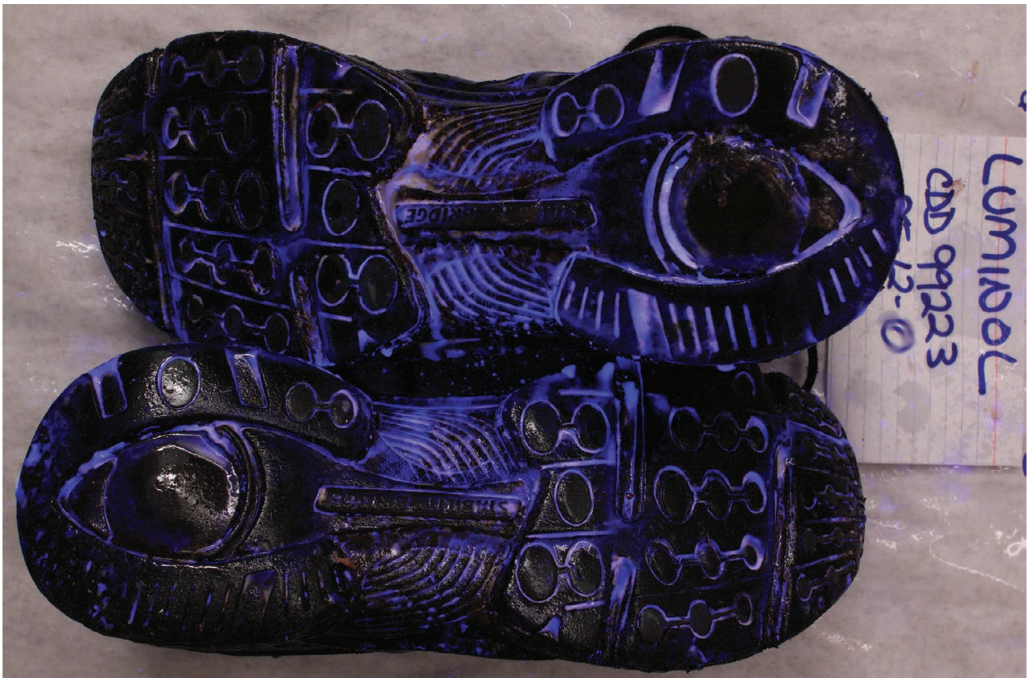

Figure 6.5 Settings: ISO 400, f/8, for 2 minutes. The photograph was captured using a small amount of ambient light filtering into the room. The exposure is actually an "overexposure." The camera's light meter showed that 30 seconds should have provided a balanced exposure. This image's capture shows the value of digital imaging and being able to adjust the composition's capture after reviewing the first attempt prior to the application of luminol and then making exposure changes to improve the final image, which included the introduction of the chemical.

In conclusion, digital photography has certainly made the photography of luminol and Bluestar reaions much easier by eliminating the amount of bracketing that was necessary in order to guarantee a quality result. Remember that luminol processing is one of the last actions of an investigator. After thoroughly documenting the vehicle and processing it for all the visible evidence, the evidence technician can prepare to process the vehicle for hidden bloodstains. Once the processing environment is prepared and all the processing equipment is readied, the photography of the chemiluminescent reactions is completed by following a few simple steps in order to record a quality photograph:

- Compose the image with the camera firmly affixed to a tripod.
- Focus the camera and then turn off the auto-focus feature.
- Set the ISO to 400 and the aperture to f/8 (unless other values are desired).
- If the room has ambient lighting, use a camera to meter the light and set the exposure for a slight (up to 2 stops) underexposure.
- If the room is fairly dark, then the exposure can run for 2–4 minutes depending on the intensity of the chemical reaction observed during the exposure.
- Remember to add in supplemental light with a flash or flashlight.

- Record an image prior to the chemical application and evaluate the composition for ambient lighting of the vehicle.
- Re-photograph as necessary and make adjustments to the exposure until the photographer is happy with the result.
- Apply luminol or Bluestar the vehicle and record the results.
- Re-evaluate the resulting photograph and adjust lighting as necessary.

Photographing luminol or Bluestar not a difficult proposition and should not be feared. The exposure is not likely recorded with the camera set to “Program Mode,” but with a little basic photographic skill and experience, excellent photographic recordings can be made quite easily.

Every crime scene photographer should practice these techniques prior to working an actual crime scene. Inexpensive substitutes to practice these techniques can be found at the neighborhood dollar store. Glowsticks and other phosphorescent toys make an excellent substitute for luminol. A photographer can find a dark room, throw a glowstick onto the floor, and attempt to photograph it using the aforementioned techniques. Photographers can then decide which supplemental-lighting technique (flashlight or electronic flash) works best for them. It is advisable to make written notes of the photographic exercises in order to know exactly how the best image was recorded. These notes can be referred to when it comes time to process an actual vehicle.

Photographing in Ultraviolet Light

Ultraviolet light encompasses energy or radiation below 400 nanometers and therefore is outside the range of visible light. In general, the purpose of adding ultraviolet light or light below 400 nm is to create or enhance a composition’s contrast through fluorescence. Fluorescence is created by the excitation of a subject’s electrons through the addition of ultraviolet energy. Contrast is created because the excitation of the subject’s electrons into a higher state of energy or orbit propels the potential evidence into the visible range of the electromagnetic spectrum. The fluorescing properties of the subject stop when the exciting light source is removed. This is in contrast with phosphorescence, which is where the stimulation of electrons into the higher energy orbit continues even after the removal of the light source. Utilizing ultraviolet light to create greater contrast and show details unseen in natural light can be an essential tool for investigators to possess in order to properly search and document a vehicle used in a crime. Ultraviolet light has a number of applications, including but not limited to help make visual the following:

- Semen, blood, and other bodily fluids
- Fibers and other trace evidence
- Forgery and document alterations
- Bruises and bite marks
- Gunpowder residue
- Fingerprint enhancements

Specifically, this chapter addresses those items that are more commonly found inside a vehicle, like human body fluids and fibers. Documentation of each of these applications will have its own unique techniques, whether the subjects are photographed with expensive alternate light source (ALS) units or with inexpensive black lights. Many times, results can be improved through the use of barrier filters, and the use of such barrier filters is discussed in this chapter.

Ultraviolet light is present in nearly all light sources. Although its presence cannot be seen by the naked eye and its existence can be felt in a number of ways. For example, ultraviolet light may cause a person's skin to tan, skin cancers to form, or glaucoma to develop in one's eyes. Among other detrimental effects, ultraviolet radiation can deteriorate photographs and other documentary evidence over time. On the positive side of the spectrum, ultraviolet light can be used to make the unseen visible. Common light sources that include ultraviolet energy as part of their discharge include the following:

- Sun
- Incandescent light bulbs
- Flashlights
- Electronic flashes (those without a UV blocking filter or coating)
- Ultraviolet light sources (LED flashlights, black lights, etc.)
- Alternate light sources

In order to use some of these light sources, the photographer needs to prevent wavelengths greater than 400 nm from entering the camera. To do this, an "exciter" or "excitation" filter may be placed over the light source. These filters are commonly available through a crime scene or photographic supply companies and allow investigators to utilize existing light sources, typically flashlights and electronic camera flashes, to capture images with only ultraviolet radiation. Excitation filters are typically placed over the light source and are used in controlled lighting (low-light) environments. On the other hand, barrier filters can be used to block unwanted light from entering the camera. Barrier filters are placed on the camera's lens. Obviously, a photographer cannot place a filter on the sun, but he or she can use a Wratten 18A or equivalent filter to block the wavelengths of light between 400 and 700 nm. The 18A filter allows radiation between 300 and 400 nm to pass through to the camera lens. It also allows a small amount of infrared light between 700 and 800 nm into the camera. Photographing with an 18A filter is commonly referred to as reflected ultraviolet photography. Reflected ultraviolet photography can be used in varying degrees of success to enhance the photography of bruises and bite marks. Consequently, ultraviolet light photography is not commonly called upon in the examination of motor vehicles. Because infrared light is passed by the 18A filter, the use of film cameras is recommended with its use. Digital cameras can record infrared light, which can defeat the value that the 18A filter is trying to achieve. Film media is sensitive to ultraviolet energy, but not to infrared energy. Therefore, film is the preferable recording media for use with the Wratten 18A (UV) filter.

The choice of a light source is up to the individual investigator or photographer. Some of those choices may be based upon availability, ease of use, and personal experience. Inexpensive light sources, such as fluorescent-tube black lights or ultraviolet LED flashlights, work extremely well in causing fluorescent reactions, especially over small areas of examination such as the interior of a motor vehicle. If an entire scene needs to be searched and photographed, a more powerful ALS may have a greater value. Filtration is likely not necessary, but may enhance the final recorded image, depending on the color of the substratum and/

or the fiber evidence itself. When conducting a search for unseen evidence, a general guideline of colored light and filter combinations are as follows:

- <470 nm (violet to blue light) and a yellow filter
- 470–532 nm (blue to green light) and an orange filter
- >532 nm (green to red light) and a red filter

Ultraviolet light photography can be recorded in color, but if barrier filters are used, then a black and white image capture may be best. Black and white photographs may provide a better contrasting image and are not as distracting as a purple-stained image might be.

As previously stated, a photographer may have to try different combinations of filters and lights. Patience and perseverance are vital. Natural light may be sufficient to photograph some trace evidence, but black lights can enhance the visualization of unseen or latent evidence. Furthermore, versatile ALS units can improve the photographic documentation of trace and fiber evidence by providing a greater range of wavelengths from which to choose from and apply to a subject. A crime scene photographer merely has to practice and experiment with their light sources. Practice and experimentation do not and should not necessarily be completed at an actual crime scene. Pick a light source and search the office, the officer's "Down Room," or even one's own home. Practice photographing what is found and record notes about how the best exposure was obtained. In this way, an investigator will have a general idea as to the best choices of ISO speed, aperture, and shutter speed when it comes time to process an actual crime scene.

Once a fluorescent reaction has been detected by whatever means, it is time to photograph the reaction. An SLR camera would be recommended, but even "Point and Shoot" cameras are capable of photographing fluorescent reactions. Photographers would benefit by recording images in the "Manual Mode," instead of the program mode. Bracketing exposures are often needed when photographing the fluorescence, and in the Manual Mode, the photographer can more quickly adjust settings. Metering an exposure recorded with ultraviolet light is similar to metering a composition painted with a visible light source. Once the subject matter is composed in the camera's viewfinder, hold the alternate light source so that it shines across the center of the composition. Begin metering the light by first adjusting the aperture and the ISO value to a desirable setting and let the camera's meter help the photographer to choose the appropriate shutter speed. Similar to working with luminol, an aperture setting of f/8 and an ISO value of 400 is a good starting point because it offers a nice balance in the depth of field and the overall image quality. Experienced photographers can adjust the settings to their preference, but when in doubt, f/8 and ISO 400 are respectable choices. Working in the manual mode, the photographer simply has to slide the shutter-speed control so that the exposure value reads "0" in the viewfinder, and the camera is predicting a proper exposure. Many photographers find that an "underexposed" ultraviolet light photograph results in a better overall image. The bracketing of exposures will provide coverage in a selection of underexposed images. Another reason to not be overly concerned with the desire to underexpose an image is because fluorescent photography is benefitted by using the "painting with light" technique. The painting with light technique helps the photographer move the ultraviolet light across the surface area of the vehicle during the exposure, and because the painting process will cause the light to move off the subject here and there, a balanced ("0") exposure effectively results in an "underexposure." The camera's metering of light was initially done with the light in the middle of the composition, thereby being concentrated and bright. However, when recording an actual image, the light source will no longer be striking the entire subject during the exposure, which results in a more desirable underexposure. In fact, additional light may likely be necessary because the light source will not be stationary during the painting process. The larger the surface area, the greater the increase in exposure may be required, because the light will move in and out of the composition by the natural actions of the painting effort. If the light source covers the entire subject and is merely moved around to avoid shadows, the exposure will be much closer to what the camera evaluated as a proper exposure. This is more common with a vehicle's interior. However, if the subject is not covered completely by the light source, then an additional stop or two of light may be necessary (Figure 6.6). As with any other critical evidentiary photograph, bracketing exposures will ensure a quality result. Remember not to change multiple variables at the same time when bracketing. Only change the aperture, length of exposure, or the painting-with-light technique with each subsequent exposure. Do not alter more than one variable at a time, because too many alterations from one photograph to the next may pass completely by what would have been the best exposure.

The basic barrier filters that accompany an ALS unit are yellow, orange, and red. However, the barrier filters that are available for cameras are seemingly endless. Barrier filters come in different shades and densities of color and are numbered using a "Wratten" numbering system. The term Wratten was named after an early photographer that developed the use of filters in photography. His name was Frederick Charles Luther Wratten (1840–1926). These Wratten filters are typically threaded onto the camera's lens and can provide an even better fine-tuning of the final image over what is seen through the standard goggles provided with ALS units. An extended assortment of barrier filters may include the following:

- Wratten #8 (yellow)
- Wratten #15 (deep yellow)
- Wratten #16 (yellow-orange)
- Wratten #22 (deep orange)
- Wratten #25 (red)
- Wratten #29 (deep red)

Unfortunately, purchasing a large selection of filters can quickly deplete an agency's financial resources, especially if different filters must be purchased for varying-sized lenses. There are adapter rings called step-up and step-down rings that can be fitted onto a filter so that they can be attached to a wider range of lens sizes. It is typically better to purchase the largest-sized filter and step down to the smaller lenses. Fortunately, fine-tuning a photograph's contrast through the use of barrier filters is only necessary for the perfectionist and, if one is a perfectionist, they probably already have an ample number of filters to choose from. For the majority of crime scene investigators, the basic colors of yellow, orange, and red will suffice.

Another way to save money is to purchase the color-tinted "viewing plates" from crime scene supply companies. These are square pieces of tinted plastic designed specifically for ALS work and can be carefully held between the camera's lens and the subject to act as a camera filter. Viewing plates also allow the photographer to observe the fluorescing material without being glued to the camera's viewfinder. Furthermore, viewing plates offer the

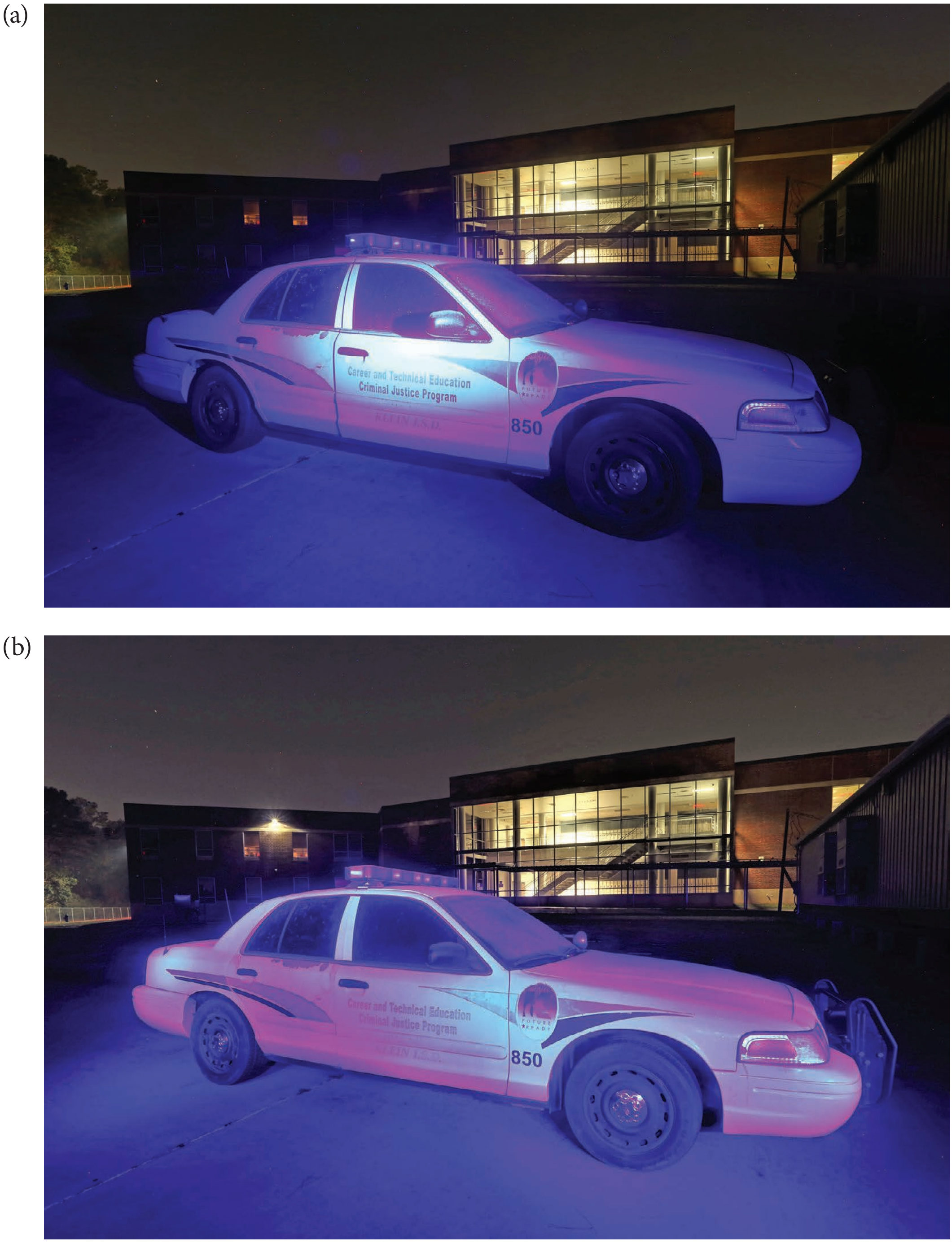
(a)
Career and Technical Education
Criminal Justice Program
850
(b)
Career and Technical Education
Criminal Justice Program
850

Figure 6.6 These images were photographed with an alternate light source (ALS) set at 415 nm. Both images were recorded with the camera set to ISO 800, f/16, and exposed for 30 seconds. When the light source is stationary as it is in (a), subjects with multiple facets, depressions, or crevices can be difficult to illuminate with a stationary light source. In addition, the light source creates a hot spot in the center of the image. However, when the light source is motioned across the entire subject as it is in (b), the overall composition is improved, and a more light-balanced image is obtained.

photographer more freedom by allowing for the quick interchange of plates to determine the best combination of colored light and colored filter. These viewing plates typically cost less than $10 apiece, which is much cheaper than the cost of three similar Wratten camera filters. The photographer only has to ensure that the light source does not strike the viewing plate between the camera lens and the plate. If light does get in between the two surfaces, distracting lens flair or dust particles on top of the viewing plate may appear in the final image (Figure 6.7).

As a final reminder, metering or evaluating light from a fluorescing subject is not difficult. The metering of alternate light photographs is fairly straightforward, but the majority of photographs will typically require longer exposure times and therefore need a tripod-mounted or otherwise stabilized camera. Since the camera must be stabilized in some manner, higher ISO values are not required. Selecting an ISO value of 100–400 will produce sharper images and less noise (or grain) and only require slightly longer exposure times as a compromise. Metering surfaces and subjects that are fluorescing or absorbing alternate light sources is exactly the same as any other photographic endeavor because one is still capturing a subject that is visible to the camera. A photographer will likely still want to bracket their exposures by one and/or two stops in each direction to ensure a quality result. The contrast of an image will change with the amount of light allowed into the camera, and a more favorable result may be captured through an intentional underexposure or an overexposure. Ultraviolet photographs can be captured in color, but the odd (violet)

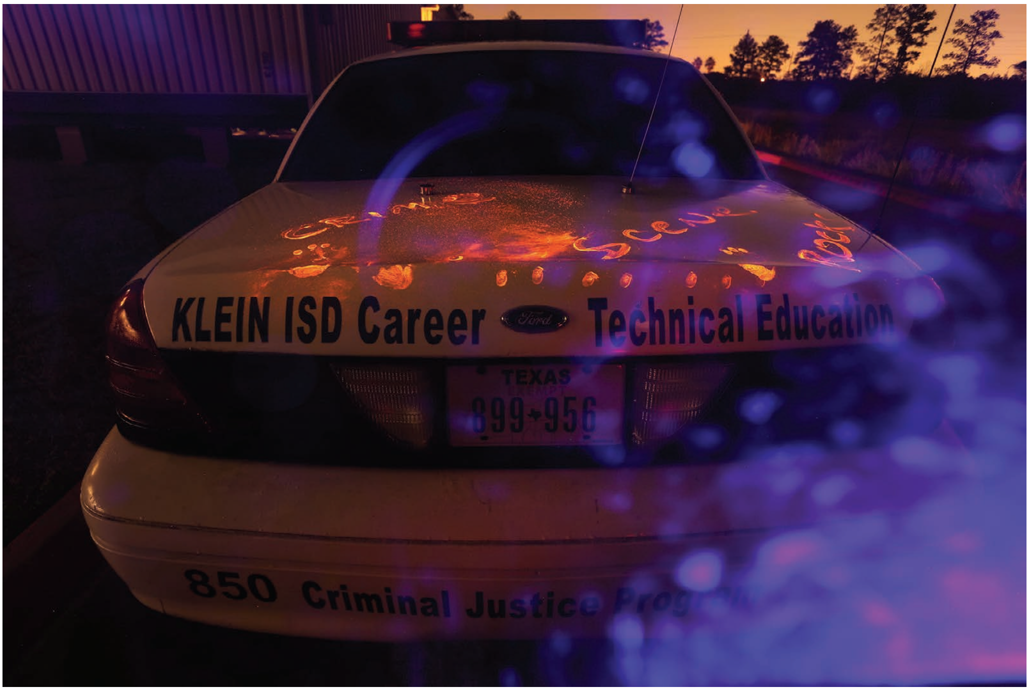
Crime Scene Rock
KLEIN ISD Career Technical Education
TEXAS
899-956
850 Criminal Justice Prog

Figure 6.7 When using colored plates for filtration, photographers need to ensure that the light source remains between the plastic plate and the subject. This photograph shows what happens if the light slips between the colored plate and the camera lens. In addition, the photographer should be careful not to bump the camera lens with the viewing plate because that might cause the camera to shake and distort the recorded image.

colored staining may distract viewers from the actual subject of the photograph. Therefore, capturing photographs using alternate light is probably best accomplished through black and white photography (Figure 6.8).

Ultraviolet light can be used to locate small threads, hairs, and fibers that might be found on a vehicle's interior. These small pieces of evidence can be particularly difficult to see in natural light. However, the visibility of such trace evidence, especially fiber evidence, can be enhanced with ultraviolet light. Many fabrics are chemically treated so that their colors remain bright and vibrant. Furthermore, laundry detergents are infused with "brighteners" to enhance the color of clothes and fabrics. Consequently, when fibers and threads fall or tear away from a garment, their detection can be made easier using ultraviolet light. These valuable pieces of trace evidence might become the critical link between a suspect and the scene. And ultraviolet light can be used to increase the intensity of these fibers and their built-in brighteners, especially when they are found on a contrasting-colored surface or a substratum that does not fluoresce similarly to the fiber evidence. Once again, ultraviolet light assists in creating contrast, causing the trace evidence to stand out against the background (Figure 6.9).

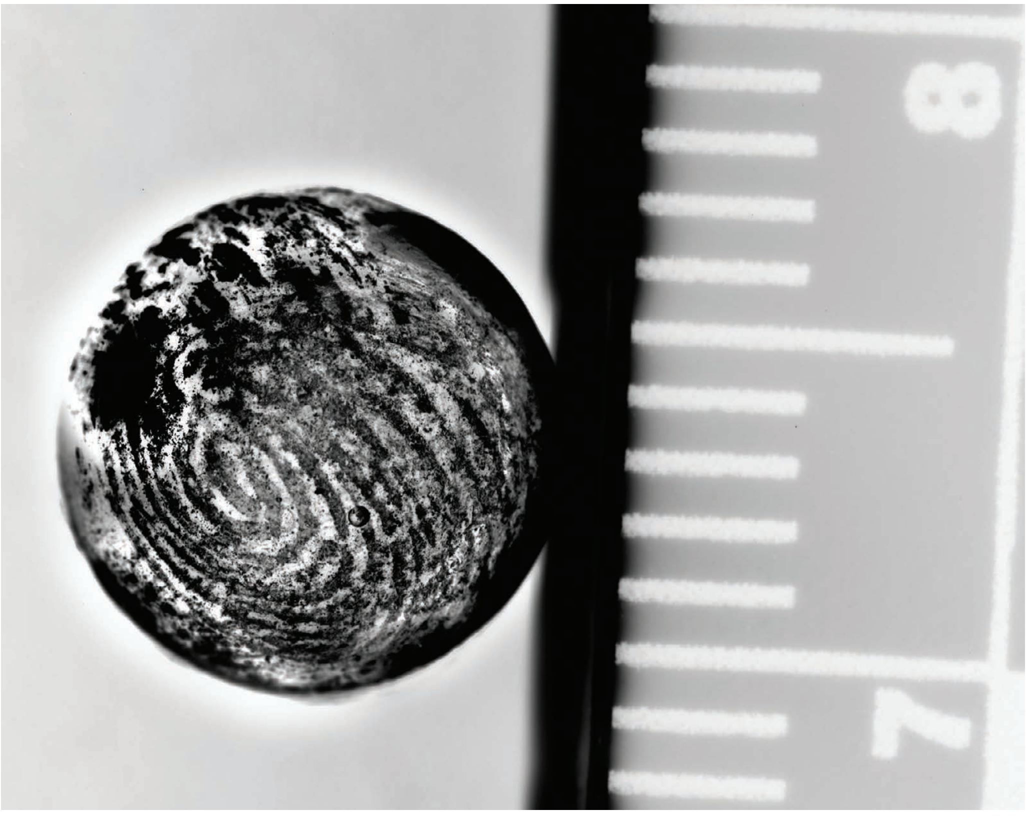

Figure 6.8 The purpose of using ultraviolet light is to make unseen properties in a subject visible. In this photo, the unseen property is a fingerprint developed on top of a small drug capsule. The latent print was enhanced with Rhodamine 6G. The light source was a SPEX Crimescope set to "CSS" and an orange barrier filter was used to capture the image. (Photograph by Laura Tierney, US Immigration and Customs Enforcement. With permission.)

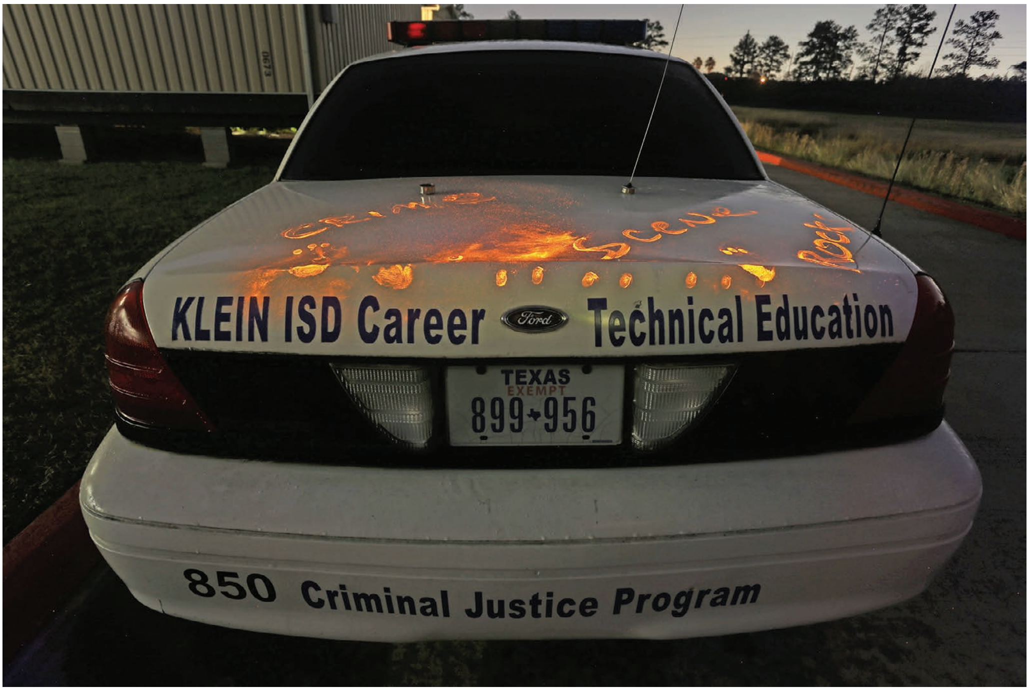

Figure 6.9 This image from the vehicle's rear trunk was recorded with an ultraviolet light and fluorescent fingerprint powder. The image's camera settings were ISO 200, f/5.6, and an exposure time of 30 seconds. In addition to fluorescent fingerprint powder, ultraviolet lights can be used to search for other types of evidence, including body fluids, fiber evidence, and some types of gunpowder residue.

Photographing Laser Trajectories

Crime scene investigators will routinely process vehicles involved in shooting incidents. The overall documentation process of shooting incidents is covered more thoroughly in Chapter 9. What follows here is the specific technique of photographing laser trajectories and reconstruction efforts. Even small agencies will come across a vehicle that has been turned into Swiss cheese due to a gunfight. Photographing shooting reconstruction efforts with trajectory rods, colored string, or lasers is best done at the scene of the crime. When reconstructions are completed at the scene of the crime, trajectories can be traced back to the approximate position of the shooter and more valuable photographs can be recorded than in a police-impound parking lot or garage. However, even in the garage setting, trajectories can be recorded through photographs and still be valuable, especially if supported by quality measurements. The documentation of the bullet strikes on a vehicle are better documented through mathematics in the garage and that information, along with other important notes, is discussed in Chapter 9.

Photographing vehicles involved in shootings that have already been towed to a vehicle examination facility can easily utilize trajectory rods and sometimes utilize colored string to demonstrate bullet trajectories. However, at crime scenes, the flight paths of fired bullets tend to be longer in distance, and the effects of gravity and wind can cause a number of challenges to stringing efforts. The effects of gravity and wind can be overcome by using lasers to represent the approximate flight paths of fired bullets. Lasers can be photographed with a little additional effort and patience, and the results will be much more vivid than with surveyor's string or flagging tape. In addition, a laser beam can span hundreds of feet and still provide as straight a trajectory line as if a string were stretched across the width of a hallway. Juries expect and believe that crime scene investigators have the latest and greatest technologies available at their disposal. Investigators and photographers must address and meet this "CSI Effect" expectation, which is easily accomplished with a few impressive laser trajectory photographs. The tools needed to create effective pieces of demonstrative evidence can be purchased for much less than one might think, and yet the results can be stellar.

As with everything else in a crime scene investigator's arsenal, forensic supply companies sell shooting reconstruction kits and laser trajectory kits. These kits can cost up to several hundred dollars and are excellent tools for determining and calculating angles of impact, but the lasers provided with the kits are often powered by small, watch style batteries. Even with brand new batteries, the power of the lasers is quite low and can be recorded only in low-light conditions. However, most crime scenes will have some ambient lighting that will cause difficulty in capturing the laser beam in the photograph. Therefore, it is suggested that a slightly more powerful laser be purchased at a hardware or home improvement store.

Inexpensive lasers can yield a quality photographic image in nighttime and/or low-light conditions. Class IIIA lasers have less than 5 milliwatts (mW) of power and include the typical laser pointers used for teaching and laser levels used in construction. The lasers powered by AA or AAA batteries are best because the beam will typically be more intense and last much longer than those powered by small watch batteries. Laser pointers found at hardware stores have two additional advantages over the handheld lasers used by instructors. "Torpedo" or laser levels found at the home improvement stores typically have a tripod mount. The threaded-screw hole can be attached to a photographer's tripod. Speaking of tripods, investigators will need two tripods to complete a laser trajectory photograph: one for the camera and one for the laser. The second benefit offered by a construction-style laser is that it should have an on–off switch. The on–off switch helps conserve battery power and is a useful feature when multiple trajectories are photographed. Laser pointers designed for teaching and shaped like pens can be used, but a homemade housing must be built to hold the laser pen steady during the exposure (Figure 6.10). As will be described, the laser must not move during the exposure or the result will be anything but useful. Homemade housings can be made in several ways. However, adopt the following steps to construct a very practical laser pen holder, with a tripod mount and on–off switch:

- Start with a small block of wood, approximately 4" × 8" × 1" (or one that accommodates the size of the laser pen).
- Drill a ¾" diameter hole through the length of wood and equal to the length of the laser pen minus about ½".
- On the bottom of the block of wood, "hammer" in a ¼" nut for the tripod mounting screw (a small amount of wood glue can be added to secure the nut). This will serve as the mounting nut for the tripod.
- Measure the distance between the rear of the laser pen and the "On" button.
- Measure from the back of the previously drilled ¾" hole and drill a vertical hole completely through the top of the wood so that it intersects the interior tube.

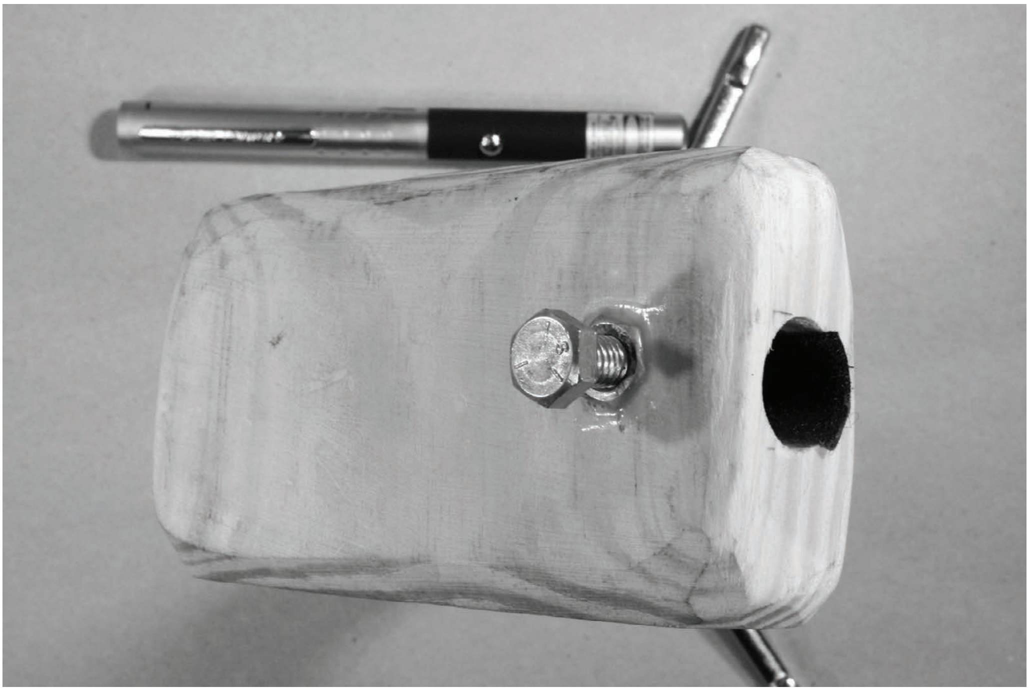

Figure 6.10 This photo demonstrates one possible design for a laser pen holder that was adapted for use as a crime scene trajectory laser. Any custom design will work, as long as it allows the device to be mounted to a tripod and allows for the pen's "On" switch to be held down during an exposure.

- Secure a nut (hammer in the nut) with a threaded bolt into this top hole, and this will act as an on–off switch by screwing the bolt down onto the laser pen's on–off switch.

Investigators will need one more item to make the laser visible to the camera and that is something to reflect the laser's beam back to the camera. Class IIIa lasers are only visible when they come into contact with an object. They cannot show a visible beam of light without assistance. Crime scene supply companies sell "Photographic Fog" packaged in an aerosol dispenser can for approximately $20 per can. Considering that laser trajectory photographs are rarely captured on the first attempt, the $20 per can expense makes such a product cost prohibitive. Less-expensive alternatives have been suggested ranging from baby powder to cans of compressed air. Even if such products costs just pennies, dispensing a huge cloud of fog or powder across a crime scene is ludicrous. The only piece of equipment an investigator needs is a scrap piece of paper. Those who wish to be a little more creative can make more durable reflective cards (Figure 6.11). More durable reflective cards can be made out of foam core boards purchased in the school supply section found in many different stores. A solid white card, a black card with a smaller white center, and a black card framing a smaller section of translucent material, such as wax paper or a glassine material, can all be useful. Although the use of these materials may be completely befuddling at this point, their value will be perfectly clear by the end of this chapter.

Typically, laser trajectory photographs are limited to nighttime or low-light conditions. This fact has been a somewhat limiting factor in providing laser trajectory images to juries

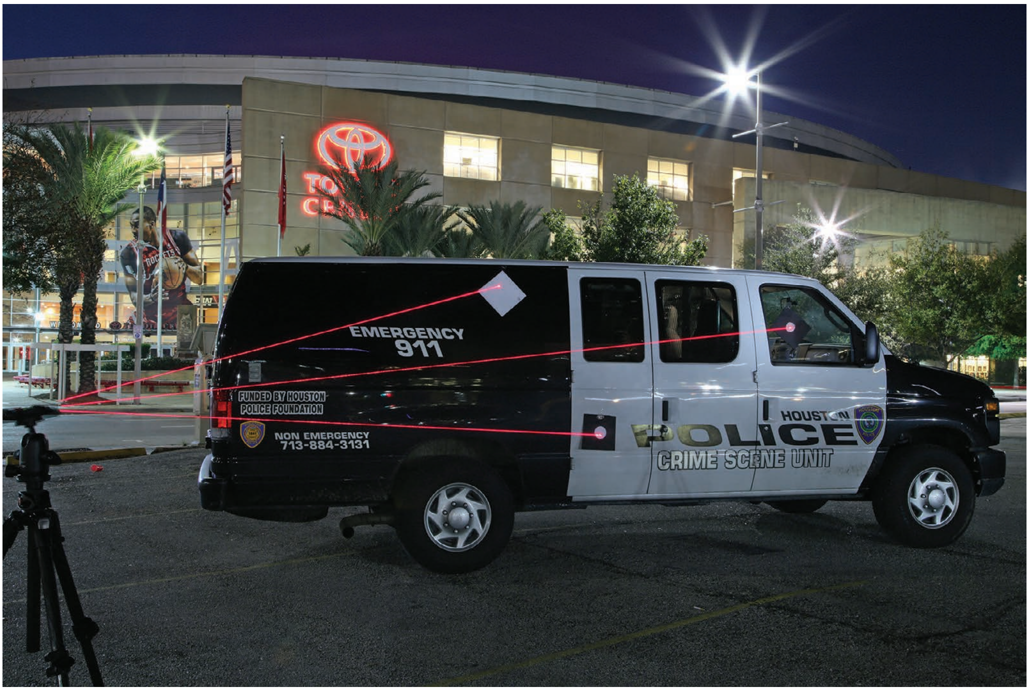

Figure 6.11 Pictured here are three different reflective cards that were used to reflect a laser's light back to the camera. The reflector on the far right has a hole cut into the middle of two pieces of black cardstock. Sandwiched between the two cards is wax paper. When the laser's beam strikes the wax paper, the beam of light can be photographed from in front of the laser instead of from behind. The other two reflecting cards are black and white cards, which can be used in different lighting conditions. Although having a variety of reflecting cards available is advantageous, all an investigator needs is a scrap piece of white notebook paper to fulfill the need for a reflective surface.

and investigators. However, daytime laser trajectory photographs can be recorded with the assistance of higher-powered lasers. Daytime laser photographs are discussed later in this chapter. For now, the basic process of reconstructing shooting incidents with lasers will involve low-light and nighttime environments. Whether it is daytime or nighttime, photographing laser trajectories is a rewarding experience. In addition to being fun, it is a way to impress the viewers with these images and leave a lasting impression. A small laser level's beam is merely a small red dot in space. The recording of a laser's beam of light is similar to the photography of a fireworks display (Figure 6.12). A photographer does not set out to photograph a firework display by hand holding the camera and taking a 1/60 of a second exposure and expect to capture the full brilliance and magnitude of a rocket's full burst of light. Photographing a firework display requires a tripod-mounted camera and a timed-exposure recording, typically, over the course of several seconds depending on the intensity of the display. Capturing a beam of light from a laser is exactly the same. The laser may produce only a bright dot of light on the target, but by reflecting that one dot throughout the entire length of the beam, an entire beam or line of light will become visible in the recorded image. Light is additive, and adding all those dots of light during a timed exposure will create the desired line of the trajectory.

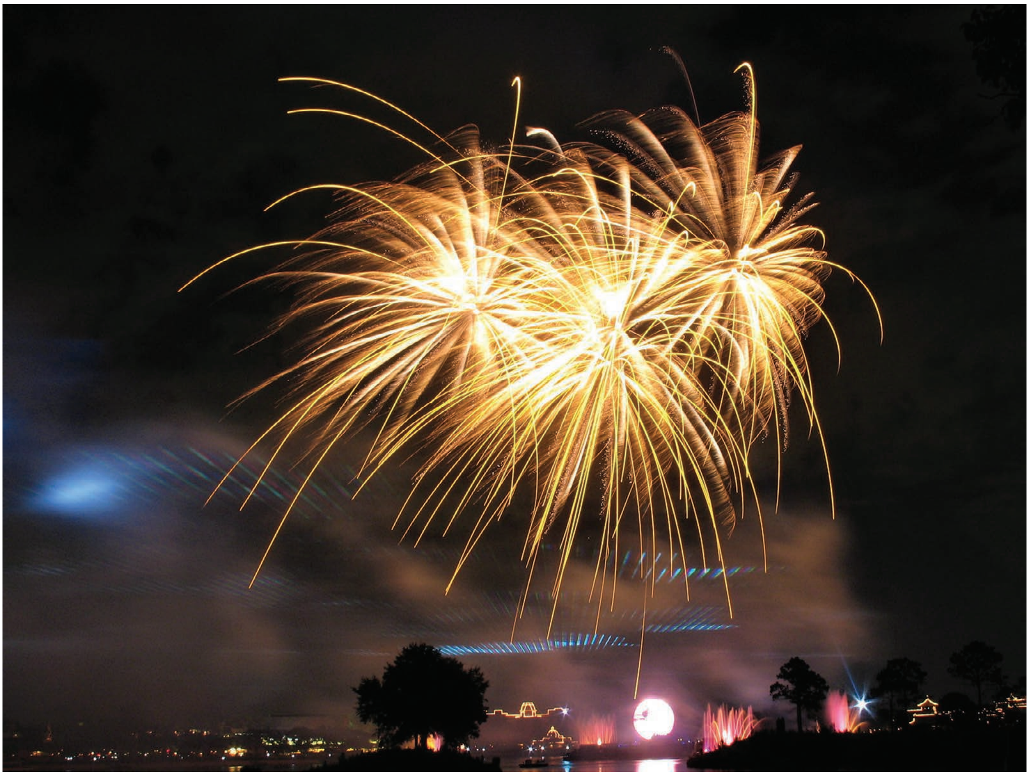

Figure 6.12 Photographing a shooting reconstruction by laser is similar to photographing a fireworks display. Recording the light produced by a firework's rocket is accomplished through a time exposure. The time exposure records the entire flight of the rocket as if it occurred in a single moment in time. This photo was recorded at ISO 400, f/19, for 2 seconds.

Similar to painting a crime scene with light, the "big picture" must be envisioned by the crime scene photographer, not just the incremental steps that create the final image. Light is additive on film or digital media (Figure 6.13). Consequently, any light seen by the camera at any point during the exposure will be visible in the photograph. Obviously, the more intense the illumination source, the more intense that particular light source will be in the recorded photograph. If the light does not move, the size of the light will grow larger and stronger in the image. If the light moves through the image, it will cause a streak to develop within the image. For example, if a car drives through a nighttime crime scene with its headlights on, streaks of light will appear through the image. Photographing a laser is quite similar, but instead of the light source moving through the crime scene, a reflecting card is moved through the scene.

Before starting the photographic process, an investigator must locate the point of impact and the approximate position of the shooter at the time the weapon was fired. The shooter's position can be established by witness statements or mathematical calculations based on the impact site. Either way, once the approximate position of the shooter is determined, the laser can be positioned in the appropriate spot. If the laser is attached to a tripod, the height of the tripod can be fine-tuned to meet the approximate height of the shooter. In addition, tripods have multidirectional adjustments. Consequently, once the

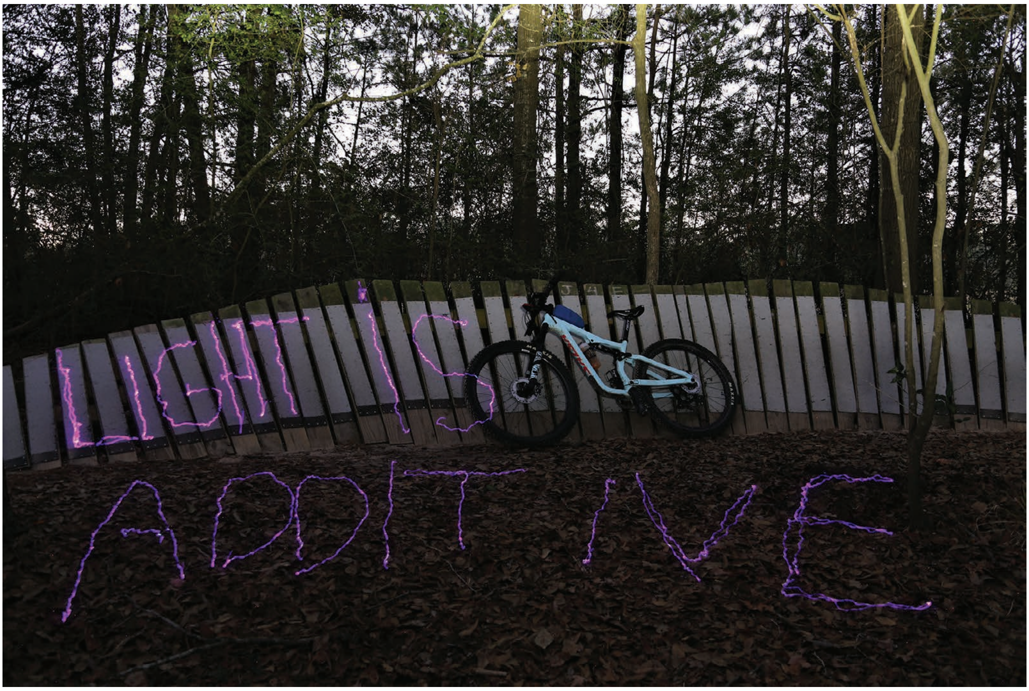

Figure 6.13 Light is additive. Photographers need to imagine the end result or the "big picture," not just the individual segments that make up a photographic image. This photo is of an instantaneous appearing image that was created letter by letter over time. The exposure was recorded at ISO 400, f/5, for 128 seconds, and the words were created by spelling out the letters with a laser pointer.

laser is turned on, its projected light can be positioned directly onto the impact site. Once the laser is positioned, the camera needs to be positioned. The camera can be positioned almost anywhere the photographer desires. However, in regard to the laser beam's light, the background must be taken into consideration. The laser produces a light that is to be made visible in the picture and that light can be absorbed or overpowered by a background that is too bright or by other distracting light sources. In addition, when a laser is photographed from a perpendicular or angled orientation, the beam will not be as vivid as a beam that is photographed from the same perspective (parallel) to the laser's travel path.

A laser beam photographed from directly behind or directly in front of the laser will produce a much denser line or beam in the captured photograph (Figure 6.14). The beam of light records by overlapping itself and therefore is more vivid in the recorded photograph. In contrast, photographing a laser's light from a perpendicular perspective may not be as intense because the particles of light are more spread out and therefore diffused. When the nighttime environment leans toward brighter conditions due to ambient lighting, a more intense beam of light will be created if the camera is positioned with the laser beam traveling in the same direction as the camera is pointed; this will offset the bright ambient light. Slowing the speed of tracking or tracing of the laser may also help improve the beam's intensity. "Tracking" the beam is the way in which the laser's beam is recorded and will be described in greater detail later.

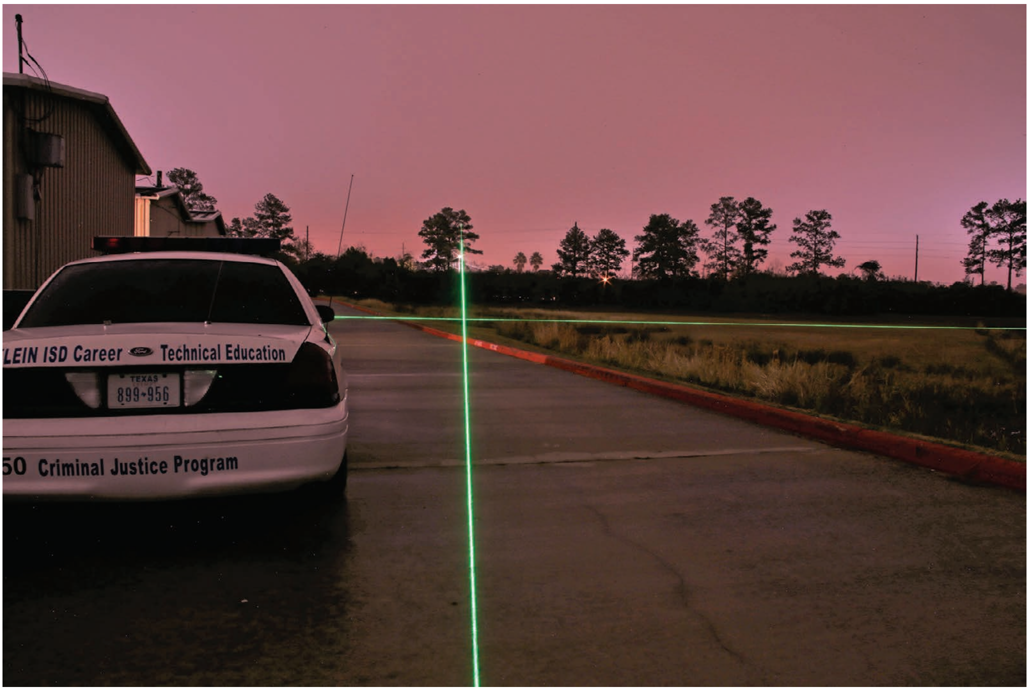
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Figure 6.14 The exact position of the camera in relation to the approximate flight path of a fired bullet represented by the laser is a decision best made by the photographer based on the environment. If all variables are equal, the intensity of a laser beam photographed from a parallel orientation will be more intense than recorded from a perpendicular orientation. However, the photography of a laser beam from a perpendicular orientation can be improved by a slower tracking of the laser beam, thus giving the light more time to record on film. One can notice how dense or thick the laser's path of travel as compared to the laser moving from left to right across the photograph.

Now that the camera and laser are positioned, the next step is to determine a starting point for the exposure. Time is on the side of the photographer and an ISO 100 setting is suggested because it will give the investigator more time to complete the reconstruction. Higher ISO values can be chosen, but they place restrictions on exposure lengths. It all depends on the amount of ambient light present in the composition. The investigator next estimates the length of the exposure and matches the shutter speed with the approximate amount of time believed necessary to track the laser beam. The tracking time is the time necessary to slowly, but steadily, walk between the shooter's position and the target, and then return. The investigator will be walking with the reflecting card through the composition at this time, thereby creating a line of light or a bullet's flight path. This estimation will provide the time or the shutter speed value of the exposure equation. The aperture can then be selected based upon the ambient lighting conditions. For example, the investigator believes it will take approximately 30 seconds to track a particular trajectory. Setting the camera with an ISO value of 100 and a shutter speed of 30 seconds will allow the camera to determine the third exposure value, the aperture. Most cameras stop metering light at 30 seconds and, if additional time is required, investigators will have to use reciprocity and adjust the exposure values to determine the appropriate final settings. Remembering how difficult it is to overexpose when recording photos at night, photographers should not be overly concerned about overexposing the image as long as harsh light sources are removed from the image's composition. For example, assume that a particular image requires approximately 2 minutes to complete the trajectory's tracking and the camera shows that a proper exposure of f/11 at 30 seconds will provide a balanced exposure. Because 30 seconds is two stops less than 2 minutes, an increase of two stops of light can be offset by a decrease of two stops of light in the aperture. Therefore, moving the aperture from f/11 to f/22 and a 2-minute shutter speed will provide the same exact exposure. A one stop "overexposure" would be equal to a 4-minute exposure. As one can imagine, a one stop overexposure at night leaves plenty of room for error. As repeatedly mentioned, bracketing of the exposures will also ensure that a quality image is recorded.

When completing laser trajectories, the camera's shutter dial should be set to the "bulb" setting, even if the exposure is expected to be less than 30 seconds. The camera must be allowed to record the entire length of the laser's beam and not unintentionally turn off before the beam's recording is finished. It is alright if the length of the exposure is little longer than the amount of time needed to track the laser beam. One just does not want to come up short and record only a partial trajectory. Therefore, a general assessment of the camera's settings will include an ISO value of 100, a bulb setting for the shutter speed, and an aperture size determined by the camera and based upon the ambient lighting conditions. Typically, the aperture will tend to be toward a smaller opening due to the longer exposure times associated with laser trajectory photographs.

The term "tracking" has been referred to several times in this chapter but has not yet been fully explained. Basically, the recording of a laser beam is completed by "tracking" or walking along the length of the projected laser beam with a reflective card. The card is not necessarily reflective like a mirror, but just a light-colored surface that causes the dot projected by the laser device to be clearly visible to the camera. The card needs to be angled back toward the camera while being walked through the composition, so that the laser's dot is visible to the camera. This may be a little more difficult for a camera aligned perpendicular to the trajectory. However, it is possible; it just means the investigator must take more care when reflecting the light's beam so that it does not develop any breaks as it is drawn into the photograph. The physical presence of the photographer should not be visible in the final recorded photograph because the individual is not illuminated like the laser's beam. In addition, because the photographer is moving throughout the exposure and not stationary for an extended period of time, their presence is not likely to be visible in the recorded image. The same theory applies to painting with light, when the photographer must walk through the scene to add flash illumination to various subjects.

The individual walking the card down the length of the laser beam must be careful not to place their body between the camera and the laser beam, thereby shielding and preventing the camera from recording the beam's light. The actual pace as the investigator walks along the bullet's recreated flight path depends on the power of the laser being used. A typical Class IIIa/5 mW laser can be thoroughly recorded with a steady, smooth walking pace. The investigator does not have to walk heel-to-toe as if performing a DWI sobriety test, but should not race to complete the trajectory's path either. Taking small strides of about 12" in length is a way to maintain a smooth, consistent line throughout the length of the trajectory. It is also important to remember that if the photograph is recorded from a side angle, the pace should be slightly slower. This is because the beam's light is not being recorded over itself as when it is photographed from a parallel perspective. Each purchased laser will have different intensities and therefore should be experimented with prior to using the laser on an actual crime scene. Investigators should practice tracking lasers with their personal equipment so that they will have an idea of the pace that results in the best image.

A sharper or more intense laser beam can be recorded if the tracking of the beam is done in both directions—from point of origination to point of impact and back. This will also help conceal any gaps in the illuminated laser line that may have occurred because the beam fell away from the reflecting card for a step or two. As a result, when estimating the length of one's exposure, the time needed to walk up and back must be factored into the equation. If in the course of tracking the beam, the laser's projected dot falls away from the reflecting card, an investigator can simply back up a short distance before the beam's light was lost and reengage the laser, continuing the tracking process. This action will ensure that there are no unwanted breaks in the recorded beam of light. At worst, there might be a slightly visible increase in the beam's intensity where it was tracked over a second time. However, the increase in intensity is more desirable than having a gap in the recorded line of trajectory. The photographer should also be aware that if the laser beam is left on the impact site for too long or at any single point, a large ball of light may form on the image and be very distracting to the overall composition. The recorded beam itself will be straight regardless of how much the reflecting card is bounced around during tracking (Figure 6.15). This occurs because the light's beam is stationary. The reflecting surface is moving, but to the camera, the line of trajectory is stationary. Furthermore, the reflecting surface should not be visible in the final image, and so there will be no visible movement in the photograph.

As a review, the following steps should help investigators create excellent results with laser trajectory photographs:

- Position the laser to simulate the flight path of a fired projectile.
- Position the camera so that the laser's beam is fully within the camera's view and that harsh or distracting light sources are limited in the composition (as best possible).
- Set the camera to ISO 100 unless the scene is extraordinarily dark.
- Estimate the length of time the investigator expects it will take to walk the length of the laser's beam twice (once up and once back).
- With the time value estimated and an ISO value selected, the camera can select an appropriate aperture value.
- Alter exposure values using reciprocal adjustments if any changes are necessary
- Complete reconstruction photograph and record a series of bracketed exposures by changing the size of the aperture or adjusting the length of the exposure.

For laser trajectory exposures estimated to last longer than 30 seconds, reciprocity calculations are the solution for the camera's inability to meter light past 30 seconds:

- *Problem*—The time estimation of a multiple-shot trajectory is 4 minutes of total time.
- ISO set to 100, shutter speed set at 30 seconds, and an aperture of f/8 are chosen by the camera as an accurate metering of the scene's ambient light.
- A 4-minute exposure is 3 stops of light more than the 30 seconds set on the camera.
  - 30–60–120–240 seconds (4 minutes in total time).

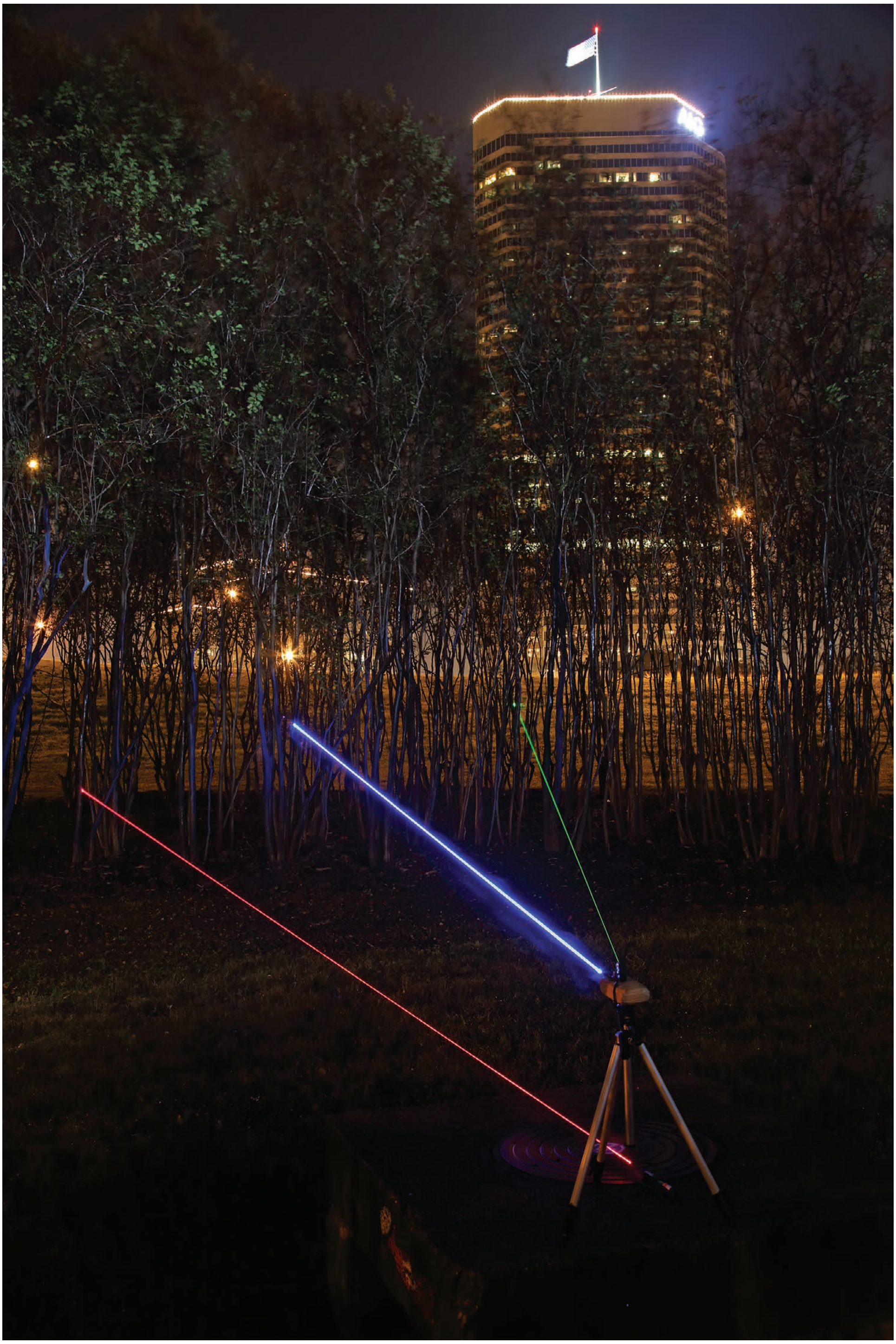

Figure 6.15 A laser trajectory photograph can be an outstanding piece of demonstrative evidence, as well as graphically representing the flight paths of fired bullets. This exposure was recorded with the following camera settings: ISO 400, at f/8, for just 10 seconds. The more powerful green laser was allowed to burn into the image without the use of a reflecting card. The purple and red lasers were tracked by two investigators tracking an individual laser's path.

- Move the aperture an equal number of stops (–3 stops of light) from f/8 to f/22.
    - f/8–f/11–f/16–f/22
- *Solution*—exposure values are equal:
    - ISO 100, f/8, for 30 seconds
    - ISO 100, f/22, for 4 minutes

A few problems can arise during laser trajectory photography. As stated earlier, light is additive to film. Therefore, if an investigator is carrying a visible radio or cellular telephone that has an illuminated feature, that feature can end up streaking through the exposure. Photographers must also ensure that no unnecessary lights are visible during the exposure, such as a police vehicle's strobe lights. Some nighttime crime scenes have areas of increased light intensity from street lights or some other illuminating light source. If the person tracking the beam's light is wearing a light-colored uniform, the individual should consider covering their uniform with a dark-colored jacket. Dark-colored clothing is less reflective and will help prevent the person tracking the laser from being visible in the recorded photograph.

One of the benefits of photographing crime scenes with digital cameras is the ability to instantly examine the image for lighting and composition. If any ghosting (Figure 6.16) occurs or an unintentional reflection becomes visible in the image, the easiest solution is to close down the aperture, and if necessary, extend the length of the exposure in order to compensate for the smaller aperture. In addition, if the photographer can identify the

(a)

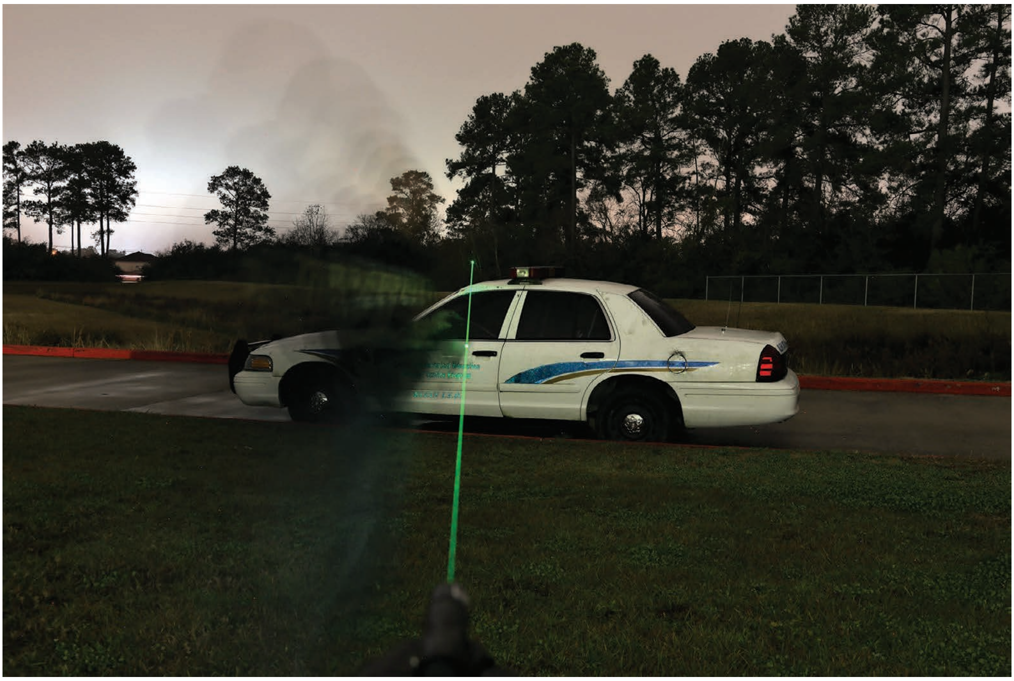

Figure 6.16 If an object creates a ghosting presence in a photograph, whether it is the individual tracking the laser's beam or the reflective card itself, the easiest correction is to close down the aperture to a smaller size and/or conceal the particular object creating the ghost impression. (a) The image was recorded at ISO 400, f/8, for 20 seconds.

(b)

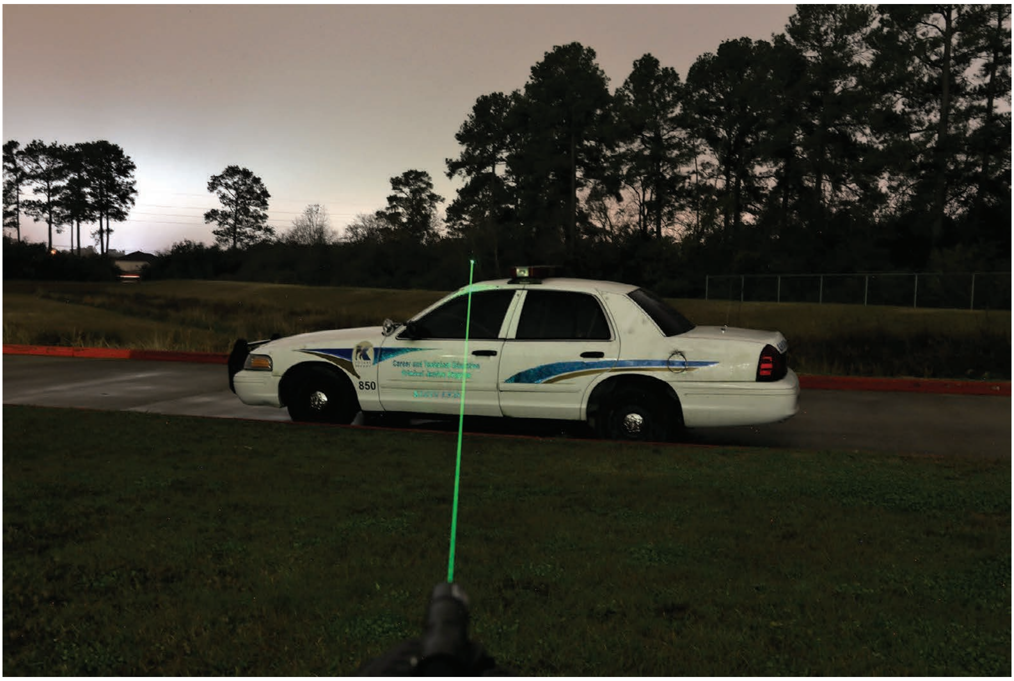

Figure 6.16 (Continued) (b) The image shows the corrected image by closing down the aperture and was recorded at ISO 100, f/11, for 30 seconds. In addition, the laser was traced by walking away from the camera on one side of the light's beam and returning on the other side. This in effect cut the physical presence of the "ghost" by half.

object that is causing the ghosting presence, the photographer should try to cover or otherwise conceal that object. Sometimes the card used to reflect the laser beam causes a halo or ghost to appear along the edges of the laser's recorded beam of light. When this occurs, not only closing down the aperture might help but also using a black reflecting card with a small white circle in the center will help eliminate or at least minimize the ghosting or halo effect. The individual tracking the laser beam may have to walk more slowly to ensure the laser beam remains in the white center of the reflecting card, but the results are well worth the extra effort.

Reflecting cards can be made in a number of forms for different lighting conditions and different strength lasers. One useful reflecting card is made by taking two pieces of black foam core or poster board and cutting a 3" or 4" hole in the middle. The 3" to 4" center of this frame can be covered with a wax paper or other translucent material. This new card is not designed to reflect the laser beam, but to cause the beam to become visible along its projection line, which will then allow the camera to be positioned looking toward the actual laser itself. In other words, the laser will be aimed toward the camera and the photograph will illustrate the trajectory from the target's point of view. Tracking of a laser beam from this unique perspective occurs in the same fashion as if the light were reflected back toward the camera. The laser's beam will strike the translucent material and becomes visible on the opposite side and therefore visible to the camera. This particular point of view or perspective can be used to show what a victim or complainant observed at the time of a shooting (Figure 6.17).

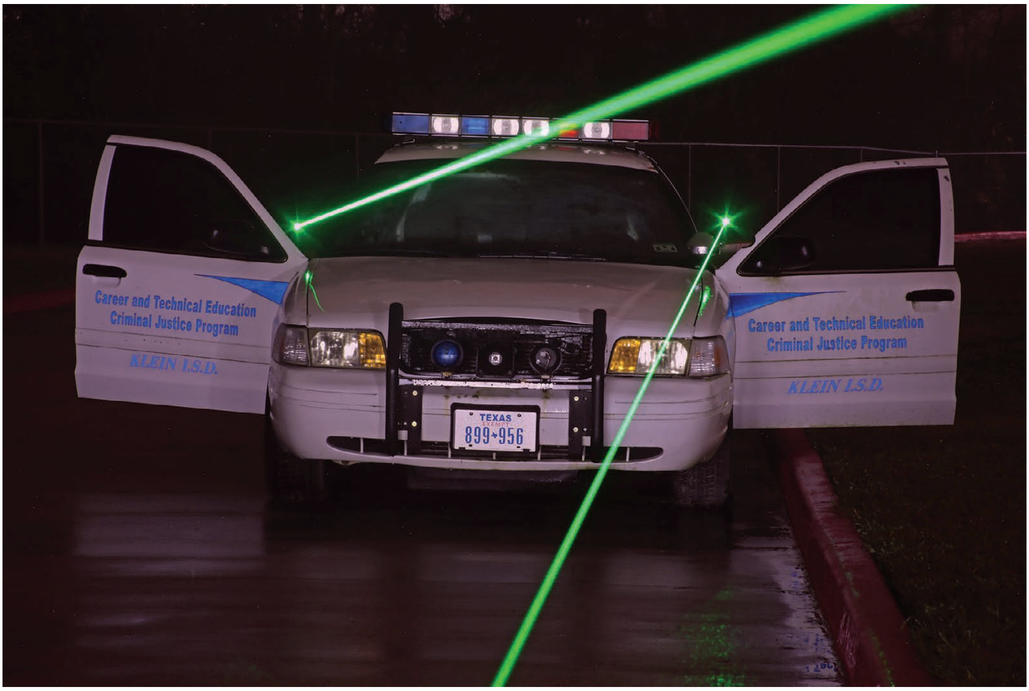

Figure 6.17 In order to take a photograph from a victim's point of view, the standard reflecting card cannot be utilized. Creating a foam-core frame with the interior of the frame filled with a translucent material such as a wax paper will allow the tracking of the laser beam to occur just as before, but will allow the photograph to be captured from the unique perspective of the victim's point of view. This photo was recorded at ISO 400, f/16, for 38 seconds.

A majority of shooting incidents involve more than just one shot fired. Multiple trajectories can be photographed in the same image for a piece of demonstrative evidence that will definitely create a lasting impression with the viewer. Recording multiple trajectories in a single photograph requires neither multiple tripods nor additional laser devices. An investigator needs only one laser but will need additional time to complete the tracking of additional trajectories. Once again, it is difficult to overexpose nighttime photographs, which provides a great deal of flexibility for exposure evaluations in low-light conditions. Simply be observant of harsh or point light sources and try and keep them out of the image's composition.

The setup for a multiple-trajectory photograph is orchestrated like a single-trajectory image. The ISO is set to 100, the expected time of tracking all the flight paths is estimated, and an appropriate aperture is selected based on the ambient light conditions. Nothing has changed except that the time estimation has increased. Therefore, some reciprocity calculations will be required of the photographer. Bear in mind that a single stop of light is one-half or twice the amount of light added or subtracted from an exposure. Therefore, a photograph calculated to take 2–3 minutes to complete the exposure will only be a single stop "overexposed" by recording an image of 4–6 minutes in length. A single stop of light should not be detrimental to the overall composition of an image. However, photographers must do everything possible to keep any point or harsh light sources from being visible in the image. Positioning the camera to keep the physical sources of light from being visible will go a long way toward improving the overall appearance of the image.

Multiple trajectories may involve a shooter who remains in relatively the same position and discharges multiple shots or who discharges numerous shots from different firing positions. Consequently, prior planning will prevent delays in recording the photograph. Investigators should have a solid idea in regards to each shooter's and target's positions within the composition. Having a "game plan" will help prevent any unnecessary delays during the image's actual recording process. Photographers should set up everything for the first trajectory just as described earlier. Next, go ahead and photograph the first trajectory.

Once the first trajectory is completed, the camera must not be allowed to continue recording the crime scene. If the camera is allowed to continue recording the scene, then as the laser is being aligned with the next impact site, it will be reflecting off other surfaces and the resulting photograph will appear as if a kindergarten child scribbled across the photograph with a pen. There are two basic ways to stop the exposure while the laser is adjusted. One option is to use the camera's multiple exposure capabilities. Most film and some digital cameras are capable of recording two or more exposures on the same frame of film. Using the double exposure feature is the easiest solution because investigators are not rushed to set up for subsequent shots. For cameras that do not have the multiple exposure ability, the photographer can place a black opaque cloth over the lens, while the laser is being adjusted to the next impact site. This will prevent light from entering and ruining the photograph. Do not use the plastic lens cover designed to protect the lens when not in use. The physical placement and removal of the lens cover could cause the camera to move ever so slightly and a blurry exposure will result. One problem with this technique in digital cameras is the creation of "noise" artifacts in the image. Even though the camera cannot "see" the composition, it is still recording and longer exposures can cause these artifacts to develop in the image. Therefore, investigators should be swift in resetting the laser for subsequent trajectories.

Once a photographer has chosen a way to conceal the lens or stop the exposure, the laser can be adjusted to the next impact site or the entire laser and tripod can be repositioned and adjusted for the next line of flight to be tracked. Once the laser has been positioned, the camera lens can be reopened, the laser turned on, and the next trajectory tracked. Having a partner when photographing laser reconstructions is helpful, but is not required. However, the camera and laser adjustments are completed more efficiently when two investigators are working together. Always turn on the laser after the camera's exposure has begun, because the laser should not strike any one surface for a significantly longer period of time than another. If the laser is left striking the impact site or other surface for an extended period of time, that area or dot may mushroom into a large distracting ball of light. Depending on the strength of the laser and the size of the lens's aperture, this distracting increase in the size of the laser's light can occur in just a few seconds. The goal is to create a consistently sized line throughout the length of the trajectory.

Laser pointers come in different colors. They are available in red (650–655 nm), green (532 nm), and blue (470–473 nm). The blue lasers are typically cost-prohibitive; however, green lasers have become much more affordable in recent years and are not that much more expensive than a quality red laser pointer. Most affordable green lasers are typically styled like laser pointers and may not have an on–off switch that will automatically remain depressed, and less likely to possess a tripod mount. For these reasons, it will be necessary to build a laser holder as described earlier in this chapter. Having two or three different colored lasers can be beneficial when a particular crime scene involves more than one shooter. Each shooter can be represented by a different colored laser (Figure 6.18).

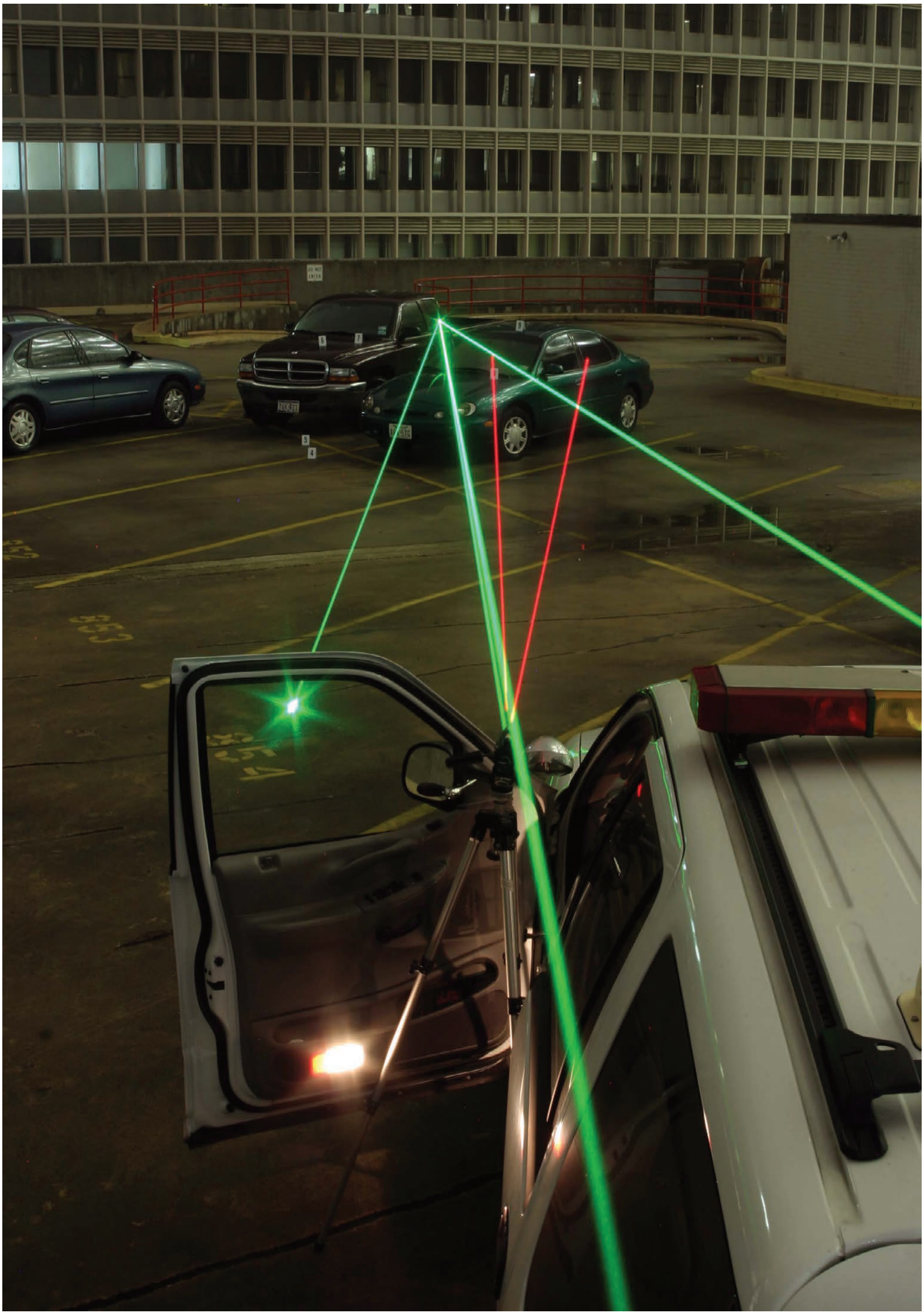

Figure 6.18 Multiple trajectories can be recorded in a single image with a little planning. The green lasers in this photograph did not need tracking and were allowed to burn into the image for approximately 15–20 seconds in each position. The two red laser paths were "tracked" by an investigator with a reflective white card. The camera's lens was covered up when either laser's position was adjusted. The overall image was recorded at ISO 100, f/16, for 126 seconds, which includes the time the camera's lens was covered with a black cloth.

Infrared Photography of Bloodstains

The techniques used for ultraviolet light photography are similar to those used for infrared photography. Photographers are merely dealing with different areas and the longer wavelengths of the electromagnetic spectrum. Investigators can use infrared light in a number of applications, including:

- Enhancement of tattoos (obscured by decomposition, blood, soot, or "removed")
- Document examinations and forgery investigations
- Gunshot residue
- Bloodstain evidence

Investigators have several options in which to restrict noninfrared light from entering the camera or cast only infrared light onto a subject. Infrared light resides above 700 nm on the electromagnetic scale. Reflected infrared photography can be completed by using filters to block all visible light waves from entering the camera and only allowing infrared light through the lens. A crime scene investigator may also choose to produce infrared light by using an alternate light source (ALS) or other infrared light source. The results may vary slightly between the two techniques, but both infrared photography techniques can produce evidentiary photographs of tremendous value. The choice of technique to be utilized may be dictated by the environment. If the photographs need to be recorded at an outdoor-daytime crime scene, a reflected infrared light photograph will be required because these images can be recorded in a well-illuminated environment. However, when the investigator is working in a laboratory where the lights can be completely subdued, the increased speed and convenience of using an infrared light source to illuminate an image may be more advantageous. The decision is up to the individual photographer and based upon experience, experimentation, and the available resources.

In reflected ultraviolet light photography, a film photographer uses a Wratten 18A filter to block visible light waves. In reflected infrared photography, an equivalent Wratten filter is used, but one designed to admit only infrared light. Film photographers will have to use specific infrared films to record these images. However, digital cameras are able to record infrared radiation. Digital imaging chips are receptive to infrared energy all the way up to approximately 1200 nm. However, the imaging chips have a barrier or "hot mirror" resting in front of them, which acts as an infrared blocking filter. Fortunately, this infrared-blocking filter only slows down the recording of infrared energy and does not completely stop one from recording images with infrared light. In conclusion, photographers are able to use their digital cameras to record all types of images discussed later. Investigators can have their camera's hot mirror removed, thereby making infrared photography much easier. However, removing the hot mirror may have some drawbacks in regard to visible light photography and is not necessary.

Infrared filters come in different densities that pass specific wavelengths of light into the camera. All of them are designed to block visible light between 400 and 700 nm. Different manufacturers may identify their filters by alternate numbering or labeling taxonomy. Investigators should check the specifications of their filters as to the wavelengths of blocked energy. A list of common Wratten IR filters includes the following:

- *# 89B*—Blocks light below approximately 675 nm
- *# 88A*—Blocks light below approximately 720 nm

- *# 87A*—Blocks light below approximately 750 nm
- *# 87C*—Blocks light below 850 nm

The 87A (720 nm) filter is the most common infrared filter used by crime scene investigators and is fully capable of producing results in most of the areas discussed in this chapter. There are other infrared filters that block wavelengths below 900 and 1000 nm, but their use is limited in the field of crime scene investigations. Because one is now photographing in just infrared light, a focus shift occurs when photographing with a camera designed to work in visible light. Cameras record and focus in visible light or that energy that resides between 400 and 700 nm. However, when recording images in wavelengths above 700 nm, there will be a shift in focus. There are several ways to compensate for the focus shift, and the easiest way is by choosing a smaller aperture, such as an f/16. The f/16 aperture extends an image's depth of field and can expand the zone of sharp focus to include the infrared focus shift in all but some macro photography compositions. Realize that the length of the exposure may be rather long depending on the light source and the camera's ISO setting. Consequently, the camera will need to be stabilized on a tripod or copy stand.

In addition to adjusting for a shift in focus, the photographer must also evaluate and control the type and the amount of light necessary to produce a quality image (Figure 6.19). One benefit of using infrared filters is the ability to work in illuminated environments. The number of potential light sources is nearly infinite and can include the sun, tungsten or

(a)

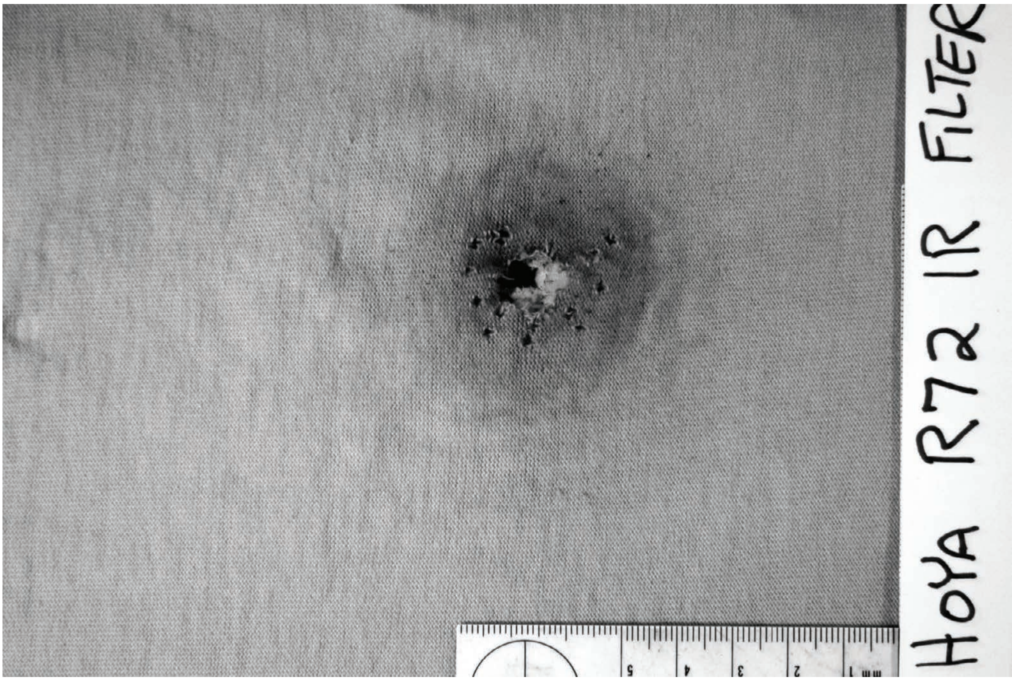

Figure 6.19 Exposure values can be quite different when photographing with infrared light. (a) The image was recorded of gunpowder residue at ISO 800, f/11, for 231 seconds and used four 100-watt lights mounted to a copy stand. With a little practice and experience, investigators will at least become familiar with where to start an exposure with different light sources.

(b)

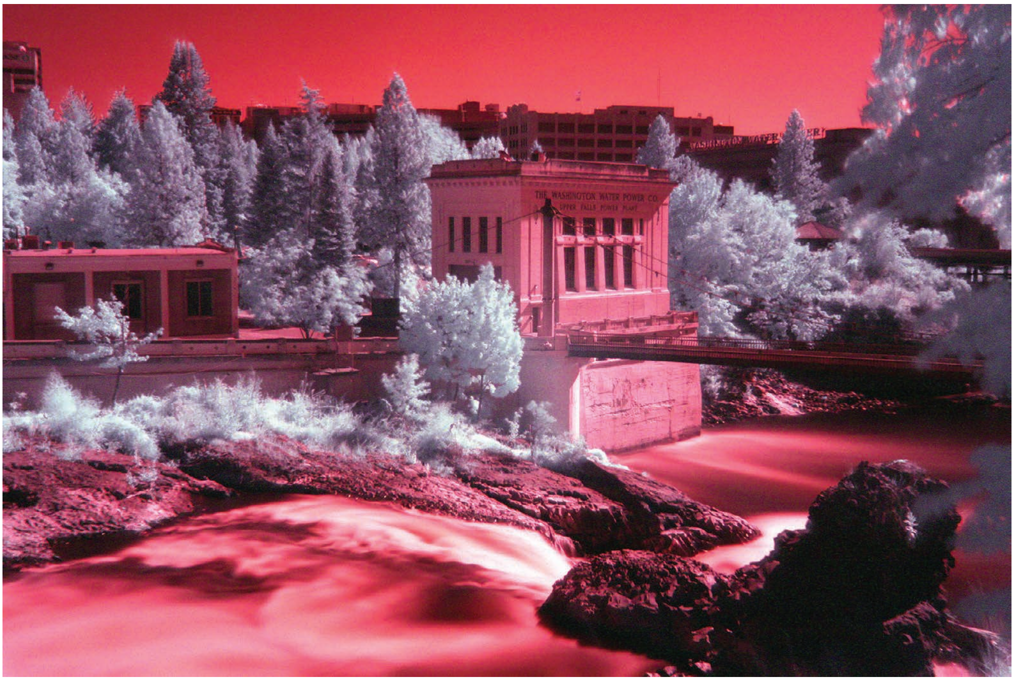

Figure 6.19 (Continued) (b) Utilizing the sun as its light source, the image was recorded at ISO 400, f/16, for 304 seconds.

halogen lights, flashlights, electronic flash, and even standard incandescent light bulbs. LED and fluorescent lights are typically not a great source of infrared illumination. Obviously, the stronger the light source, the shorter the exposure time. The sun is the best light source because of its intensity, but may not be practical if the subject is in the hospital or the morgue. If the investigator maintains a consistency in the aperture and ISO settings, for example, f/16 at ISO 400, then the combination of the light source and exposure length are the only variables that must be dealt with when working an actual crime scene. Remember that when working with smaller light sources, such as a flashlight, the light should be moved or painted onto the subject to eliminate hot spots.

When an investigator chooses to use an actual infrared light source, he or she needs to control the ambient lighting because there will be no barrier filter on the camera's lens. The investigator cannot record an infrared image when the infrared light competes with the ambient light or at least that is true when barrier filters are not employed. Infrared lights can be expensive, but they do produce a consistent beam of light that can be used to enhance the presence of hidden evidence. Investigators can also use infrared spotting scopes designed for hunters and officers working surveillance. The spotting scopes are less expensive than a full-blown ALS unit but can be challenging to find and their strength or intensity can vary widely. The Internet is a good resource to research and purchase infrared light sources. However, a homemade infrared light source can be made out of an old, discarded flash unit, exposed and developed color print film, and black duct or electrical tape. The steps to build one's own infrared flash unit are as follows:

- Expose a roll of color print film to light and develop the exposed film.
- Cut two lengths of the developed film long enough to fully cover the head of the flash.

- Lay the two strips of film on top of each other so that a double-thick barrier is created.
- Place the two-piece barrier across the flash head.
- Use black tape to secure the film barrier to the flash head and to seal off any areas where visible light may escape.

When the white light projected from the flash passes through the two overlaid sections of the film, it produces infrared light. In addition to being inexpensive, this technique can produce excellent results. This homemade IR flash technique must be utilized in a dark environment, in contrast to reflected infrared photography. The basic theory is that barrier filters block visible light and can be used in daylight conditions. In contrast, dark environments allow photographers to use infrared light sources without a barrier filter. Either technique can be used with today's digital cameras.

Before attempting to utilize the infrared flash technique on an actual crime scene, investigators need to experiment with it in order to determine the correct relationship between ISO value, aperture, and the number of full-power flash exposures necessary to produce a well-illuminated image. An ISO value of 400 is a nice balance between image sharpness and the amount of light necessary to produce an image. The aperture can be adjusted to the investigator's personal choice, but for the sake of argument, an aperture of f/16 is a good choice because it compensates for the infrared-focus shift. The length of the exposure is not important, because the darkened environment does not allow visible light to impact the image. As a result, the exposure will depend solely on the number of flashes needed to record an image, and the length of the exposure will be determined by the recycle time of the flash. Therefore, the final part of the equation is to take test exposures and determine how many full-power flashes are required to capture an infrared image. Since these photographs are typically of smaller subjects, the flash does not have to be held very far from the subject. Two to three feet between the subject and flash should be adequate. Remember to keep this same distance when photographing an actual subject. Take notes of the results in regard to ISO, aperture, the number of flashes, and the subject distance from the flash to obtain a quality result (Figure 6.20).

Obviously, digital cameras have a great advantage in infrared photography because the image can be examined immediately and compensations made if necessary. Film photographers must bracket their exposures. Remember to change only one variable at a time when bracketing. For example, add or subtract the number of infrared flashes projected onto the subject or change the ISO or aperture settings, but do not make multiple changes all at once. Too many changes could cause the picture to move from an underexposed to an overexposed without any middle ground.

Bloodstain evidence on dark surfaces is often a challenge for investigators to visualize. Infrared light can help bring out the hidden information and evidence that latent bloodstains can provide to investigators. Infrared light can be used to greatly improve the contrast between blood and the substratum it rests upon. This contrast can be the difference in being able to identify a stain pattern or never even detecting its presence. Photographing blood on black surfaces so that it is visible is an excellent way to create a lasting impression with a jury (Figure 6.21). Infrared photography can be used to help find bloodstains hidden in a vehicle's interior because of dark-colored seats and floorboards. Furthermore, locating, identifying, and illustrating to the jury through photographs all one's findings is a basic duty of all crime scene investigators.

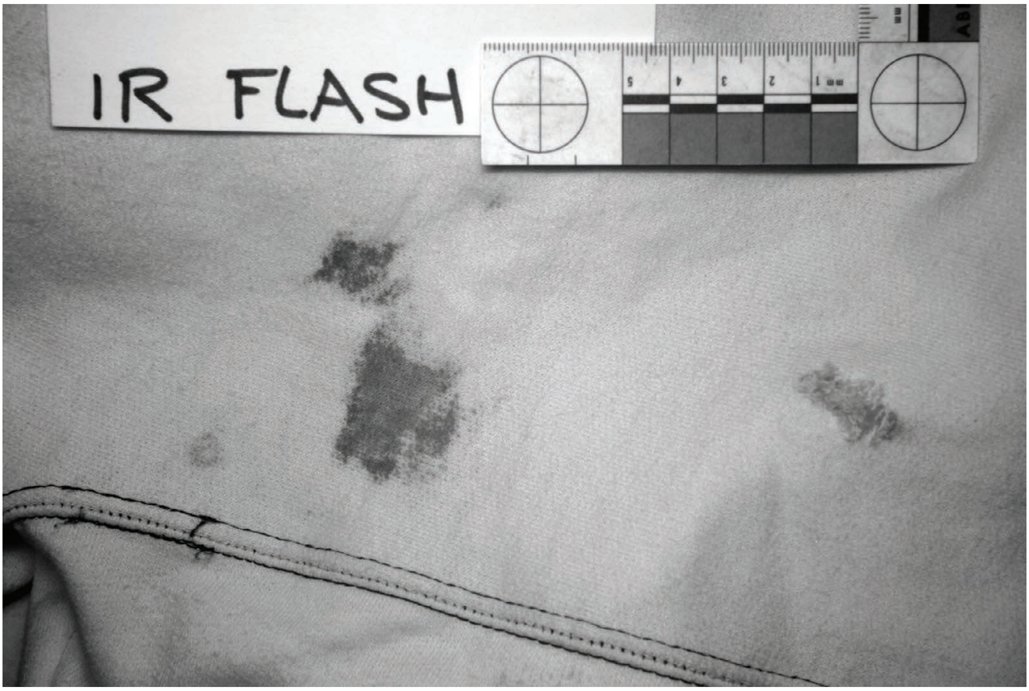

Figure 6.20 This image is of a pair of small bloodstains and a bullet hole found on a black sweatshirt. The bloodstains were nearly invisible in natural light due to the fabric's color, but a photograph depicting the bloodstains was recorded using a homemade IR flash. The flash was fired 10 times from approximately 18", the camera was set to ISO 100, f/8, and the exposure required 76 seconds to allow the flash to fully recharge between each burst of light.

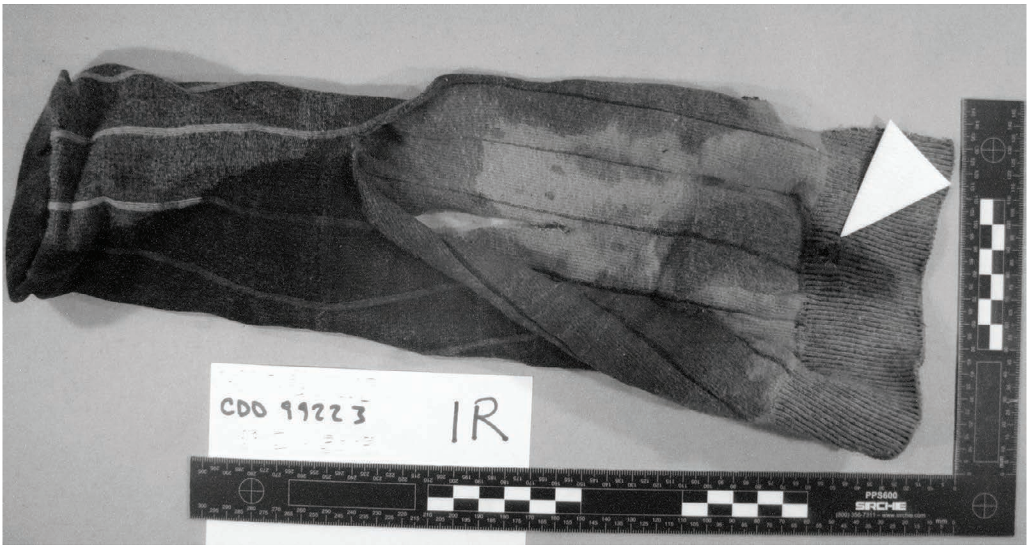

Figure 6.21 The bloodstains found on this sock were not visible in ambient light. The sock was solid black to the naked eye, including the stripes visible in this photograph. Neither the stripes nor the blood was visible on the sock until it was photographed with infrared light. The exposure settings were ISO 800, f/11, for 231 seconds.

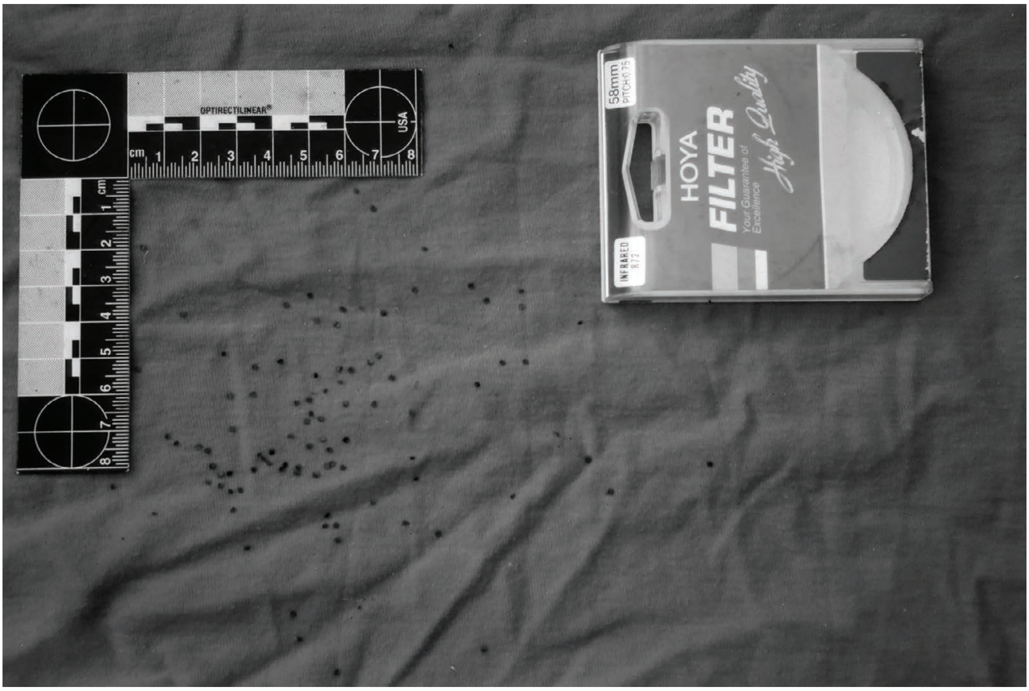

Figure 6.22 Infrared light can be used to image such things as gunshot residue and gunpowder on dark surfaces, such as the gunpowder found on the black shirt shown in this photograph. The image was recorded through an infrared filter (720 nm) and using the sun as a light source. The exposure settings were ISO 1600, aperture of f/20, and a shutter speed of 30 seconds.

Gunshot Residue

Gunshot residue, powder burns, and propellant projected onto a target are valuable pieces of evidence for crime scene investigators. Such evidence can place a gun in close proximity to the victim or vehicle's surface and may have a huge bearing on a case because knowing how close a weapon was to the target can limit a suspect's justification for or description of how the shooting occurred. Infrared light is the perfect platform with which to record such photographic evidence, especially when the color of the target's surface is dark or has a distracting pattern (Figure 6.22). The substratum can even be human skin and even skin covered with blood. Burned propellant absorbs infrared light and will photograph as a definitive black color. Infrared light is also likely to lighten the background, thus increasing the contrast between the gunpowder residue and the surface it rests on. Any of the infrared photographic techniques described earlier in this chapter can be used in the documentation of gunshot residue.

Conclusion

The documentation of evidence unseen by the human eye is an important aspect of crime scene investigation. The utilization of ultraviolet and/or infrared light provides a method for recording these valuable pieces of evidence. There are specific applications in which photography with ultraviolet or infrared light may produce results. Both forms of photography require investigators to practice the techniques and conduct tests with their equipment so that results can be reproduced consistently, especially when it comes time to work an actual crime scene. Reflected infrared photography is a little easier in the way it simply limits visible light from entering the camera, but yet allows the photographer to work in a well-illuminated environment. However, any of the infrared light techniques will work in most applications.

Unfortunately, ultraviolet light photography is not as simple. There are many different ultraviolet light sources available, and each light source emits its own particular range of wavelengths. Furthermore, these light sources peak at different wavelengths and that too can alter the photographic outcome. Compounding those variables is the necessity of adding barrier filters to the composition. Consequently, when utilizing ultraviolet light, crime scene photographers must be flexible. However, once a reaction is observed, it can be photographed. Conducting personal experiments with test photographs will enable the investigator to determine the techniques most effective in documenting crime scenes utilizing ultraviolet light photography. There is no substitute for experience, even if that experience is conducted in an experimental process.

Violent crimes frequently involve gunfire and bloodshed. Investigators will be tasked with photographing laser trajectory compositions to represent the flight paths of fired bullets, as well as photographing the bloodletting that occurred inside the car. Photographing blood is not always difficult, but when the vehicle has been cleaned up by someone, that blood's visibility can be enhanced with chemiluminescent chemicals. Chemicals like luminol and Bluestar are two such chemicals, and their photography generally requires extended time exposures to allow enough time to ensure the blood's luminescence is visible in the recorded photograph. Photographing laser trajectories also requires extended time exposures so that the entire flight path of a fired bullet can be reproduced in a photographic form by tracking a laser's beam through the composition. Crime scene photographers who are able to consistently and confidently capture these challenging photographs will be rewarded with the appreciation of case investigators and attorneys alike.

Photographers are required to produce pieces of photographic evidence that will be of value to investigators, attorneys, and jurors. Ultimately, photographs may end up being viewed by jurors and the images must meet with their expectations. More often than not, investigators must educate the jury on crime scene investigation realities. For example, this may entail explaining that blood does not fluoresce and that luminol reactions cannot be seen in daylight conditions. Consequently, becoming familiar with alternate light sources, lasers, and chemical enhancements is paramount to becoming both a premier crime scene photographer and a credible witness in court.

Additional Readings

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Review Questions: Advanced Photography Techniques of Challenging Subjects

1. Because “light is additive,” luminol reactions are generally improved through longer exposures.
    a. True
    b. False
2. When photographing hidden semen stains, which is a better source of light?
    a. Ultraviolet light
    b. Infrared light
    c. Visible light
    d. None of the above
3. Where is ultraviolet light found along the electromagnetic spectrum?
    a. Greater than 1000 nm
    b. Less than 700 nm
    c. Greater than 532 nm
    d. Less than 400 nm
4. Which colored filter typically works best with ultraviolet and violet lighting?
    a. Orange
    b. Red
    c. Yellow
    d. Green
5. Blood ________________ ultraviolet light.
    a. reflects
    b. absorbs
    c. fluoresces with
    d. refracts
6. What kind of environments are luminol reactions best photographed?
    a. Outdoor environments
    b. Low-light environments
    c. Sunlit environments
    d. Ultraviolet light environments
7. Which statement is most accurate regarding the photography of luminol reactions?
    a. Choose an ISO value of 3200 or higher
    b. Choose a shutter speed value of faster than 1/8th of a second
    c. The camera should be mounted on a tripod
    d. The best exposure mode to select is Program Mode
8. Which of the following light sources is least effective in adding supplemental light to a luminol composition?
    a. Bounced light
    b. Electronic flash
    c. Flashlight
    d. Sunlight

9. During the course of completing a laser trajectory photograph, a ghosting image of the photographer appeared in the image. What can be done to remove the ghosting appearance from the composition?
   a. Close down the aperture to a smaller opening and lengthen the exposure's time
   b. Walk faster during the tracking of the laser's beam
   c. Use fog instead of using the tracking technique
   d. None of the above, one cannot remove the ghosts from appearing
10. It is possible to track multiple lasers or multiple flight paths of fired bullets in the same photographic image.
    a. True
    b. False
11. A photographer has calculated a proper exposure to be at ISO 100, f/16, for 2 minutes. After tracking the full length of the laser's beam, the photographer still has slightly over 30 seconds left on the exposure. What should the photographer do?
    a. Walk the laser's beam again until the time runs out
    b. Paint the scene with light with the remaining time
    c. Simply let the exposure time continue and turn off the camera at the 2-minute mark
    d. Immediately turn off the camera when the tracking has been completed
12. What is an advantage of utilizing lasers when documenting shooting incidents?
    a. With a little practice, photographing lasers is relatively easy
    b. Gravity and wind do not affect a laser's light
    c. Fulfill a jury's expectation to see quality laser photographs (CSI Effect)
    d. All of the above
13. Which alignment between the laser's light and the camera will provide the densest line of light?
    a. With the camera perpendicular to the line of light
    b. With the camera aimed along the line of light
    c. With the camera at a 45° to the line of light
    d. Any of the above
14. What is best used to make a laser's dot turn into a complete line of light or a bullet's flight path?
    a. Atomized baby oil
    b. Baby powder
    c. Fog
    d. An index card
15. In laser reconstruction photography, the composition's exposure length is typically chosen to match what value?
    a. The distance of travel
    b. Aperture × ISO value
    c. Estimated time to walk along the laser's beam and back
    d. 30 seconds
16. Where is infrared light found along the electromagnetic spectrum?
    a. Greater than 700 nm
    b. Less than 720 nm
    c. Between 532 and 700 nm
    d. Greater than 400 nm

17. Infrared filters used for reflected infrared photography block what type of light from being used to create an image?
    a. Incandescent light
    b. Visible light
    c. Alternate light
    d. Infrared light
18. Which aperture is most likely capable of compensating for the shift in focus caused by infrared light?
    a. f/2.8
    b. f/5.6
    c. f/11
    d. f/16
19. What occurs after an energy (light) source is taken away from a phosphorescent object?
    a. The object absorbs all the light
    b. The object rejects the light
    c. The object continues to emit light
    d. The object stops emitting light
20. Who is credited with pioneering the use of filters in photography and has their name associated with a common filter naming convention?
    a. Charles L. Wratten
    b. Louis Lumiere
    c. Louis Daguerre
    d. Henry Fox Talbot

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Deoxyribonucleic Acid Evidence

7

If anyone watches crime dramas on television or listens to the mass or social media, they will think deoxyribonucleic acid (DNA) evidence solves every single crime and just because a suspect's DNA was not found at a scene must mean they were not there. However, criminal investigators and criminalists know this is not accurate in the least. Knowing what DNA is, how to recover it, and what the probative value of the evidence is key to understanding the true value of DNA evidence. DNA evidence has been an unbelievable tool for law enforcement ever since Alec Jeffreys (born 1950) helped identify Colin Pitchfork as a murderer in 1987. Furthermore, science has improved in leaps and bounds since those early days of restriction fragment length polymorphism (RFLP). With polymerase chain reaction (PCR) and short-tandem repeats (STR) techniques, investigators can utilize "Touch" DNA and no longer need a visible or large blob of body fluid. The science is truly amazing. However, it is the responsibility of the crime scene investigator to find this hidden gem of evidence and for the criminal investigator to place the recovered evidence into context within the criminal case.

What Is Deoxyribonucleic Acid?

James Watson (born 1928) and Francis Crick (1916–2004) have been credited with the discovery of DNA and were awarded a Nobel Prize in 1962 for their work. Watson and Crick's discovery was an important step in the overall science, but they were not the only pioneers in the science. Hereditary laws were being studied since the days of Gregor Mendel (1822–1884), the Augustinian Monk that worked on hereditary factors, dominant genes, and recessive jeans in the 19th century. To begin with, and at its most basic level, DNA is the body's instruction manual. It consists of a complex code based on four little letters: A-C-T-G. Erwin Chargaff (1905–1995) identified the four base nucleic acids that build the double-helix DNA molecule: adenine, cytosine, thymine, and guanine. DNA is even more phenomenal because adenine binds only with thymine, while cytosine binds only with guanine. These nucleotide bases are the basic building blocks of human life.

The nucleotide bases form "base triplets," which are also known as amino acids. There are 20 amino acids in the human body. Amino acids are the building blocks for genes. In turn, genes form chromosomes. Chromosomes are genetic instructions that are written in 23 chapters of the human body's instruction manual, which of course is the DNA molecule. DNA is found in the nucleus of most cells in the human body (red blood cells do not possess a nucleus). The DNA molecule is shaped like a double helix of approximately 3.1 billion base pairs of nucleotide bases (A-T and C-G). The 23 pairs of chromosomes in the human body range in size from approximately 250 million base pairs to 45 million base pairs.

Kary Mullis is credited with the development of the PCR technique that has been so beneficial to investigators. PCR amplifies DNA through a series of cooling and heating cycles of a

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sample, which causes the DNA to separate and rebuild, thereby making copy after copy of itself. For investigators, this is most important, because it allows investigators to utilize degraded samples of DNA and very small samples of DNA. Short Tandem Repeats developed out of PCR and is extremely discriminating in being able to identify a contributor, which is a fancy way of saying the person who is an exact match to the DNA recovered at a crime scene. DNA matches are made by looking at up to 20 specific areas or "Core Loci" on the human genome (DNA) and quantifying the one or two alleles present in those Core Loci. The quantified values found in these 20 locations are then searched through DNA databases managed by CODIS, the Combined DNA Index System.

Since DNA is found in most of the body's cells, DNA can be found in a variety of forms: blood, semen, saliva, sweat, and hair. There is also "Touch" DNA, which is when a person leaves behind epithelial (skin) cells when they come into contact with something or someone. Once again, we return to Edmund Locard's "Every Contact Leaves a Trace" theory. Many times, when the forensic scientist develops a genetic profile from genetic or biological evidence recovered from a scene or a vehicle, that profile may be a mixture of two or more contributors. When the mixtures are just two contributors, then the scientist may be able to separate the genetic profiles and even quantify the contributions by molecular weight. Typically, the DNA report will state something similar to "Major Contributor" and "Minor Contributor." This is one reason why, if possible, crime scene technicians collect a "known" DNA sample from the complainant or complainants of a crime. With this additional information, the DNA scientist may be better able to isolate a suspect's genetic profile.

Another reason investigators should understand how DNA profiles are generated and what the pitfalls of mixed DNA samples can cause is that the investigator should take care in choosing and collecting DNA samples. This applies to the recovery of all types of genetic evidence but is most critical when it comes to Touch DNA evidence. Investigators should strive to determine the probative value of potential Touch DNA sources. For example, the passenger's door handle of a taxicab is more than likely going to be a swamp of DNA and have no probative value. However, if during the robbery of the taxicab, the suspect pushed open the plexiglass window between the front and back seats, then that might be an excellent surface to try and collect DNA evidence.

Collection of DNA Evidence

Since DNA evidence can be found on any object that can be touched, bled on, sweated on, or licked, the potential surfaces that DNA could be found on are endless. One could swab every surface on a vehicle, but most likely the laboratory would never process every swab from every surface. Consequently, investigators need to be selective in choosing the area's most likely to possess a viable genetic profile. Of course, there is the philosophy that it is better to have the item (DNA swabbing) and not need it than to not have it and need it. This is absolutely true. Therefore, when in doubt, always make the collection. Just because the evidence technician swabs the taxi cab's passenger door handle, does not mean it must be sent to the lab immediately, other items with greater potential value can be sent to the lab first and if no genetic profile is developed, then the investigator can send the door handle's DNA swabbing off to be tested.

Before a discussion on where to look on a car for potential DNA evidence begins, knowing how to collect DNA evidence is important knowledge to gain first. There are five general manners in which DNA evidence is recovered:

- Swabbing
- Scraping
- Tape Lifting
- Cutting
- Collecting (the whole object)

Any of these five methods are valuable approaches in the recovery of DNA evidence. However, the most common method of DNA collection is swabbing. As will be discussed later, there are a number of variables and methods in collecting evidence, even among the individual techniques. The best way to ensure that the laboratory is receiving evidence in the way they prefer is to keep the lines of communication open with them. The DNA scientists who are processing and analyzing the evidence collected by the technician can inform evidence processors about how they would prefer evidence collected, packaged, and submitted. The DNA scientists will appreciate the communication, as well as making the laboratory's job easier. As an ancillary benefit, investigators will likely get much better communication about results in return.

Swabbing

The swabbing of DNA evidence is the most common method of collecting DNA samples. Because crime scene technicians will recover a plethora of DNA samples on each and every car, they must be fully supplied with the necessary tools. These tools include sterile swabs, distilled water, a water applicator of some type, swab drying board, and packaging materials. Sterile swabs are a must and can be purchased from any forensic supply company. The swabs typically come in individual paper envelopes and are packaged in pairs (Figure 7.1). The sterile cotton-tipped swabs are generally found on long, approximately 6" in length, thin wood handles or applicators. The handles make the swabs easier to reach into remote places, but are also beneficial when collecting known DNA samples from individuals. Packaging of swabs will be discussed a little later, but just to make an important note, do not throw the paper packaging away after the swabs are removed. These envelopes can be used as an intermediate container to hold the swabs once a DNA sample has been collected. The reason two swabs are packaged together is that laboratories work under the "50% Rule." The "50% Rule" states that the laboratory cannot use more than 50% of a sample when testing. Therefore, when two swabs are collected, the DNA scientist can utilize a whole swab for DNA extraction. Theoretically, if the laboratory personnel can only utilize 50% of any remaining sample, technically it will never run out.

Most agencies will have budgeted for DNA swabs for their evidence and laboratory personnel. However, for training purposes or one of those emergency circumstances when there are no more swabs left in the evidence processing kit, investigators may wish to keep an emergency supply of swabs from the local drug store. If swabs are going to be used from a bulk supply source, there are a couple of cautions. First, use gloves when retrieving swabs

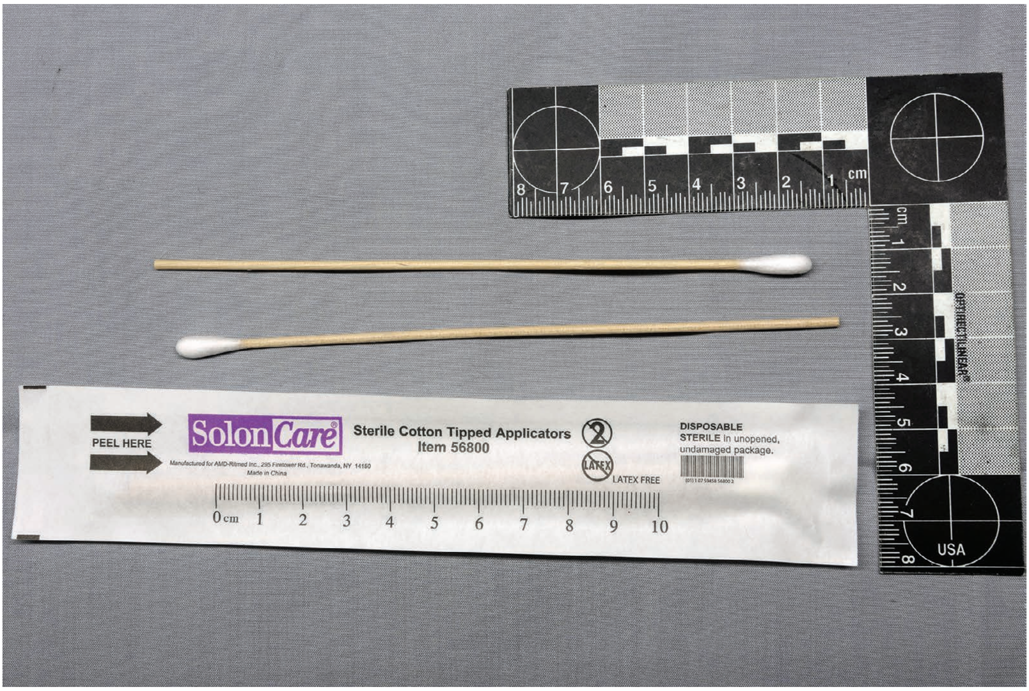
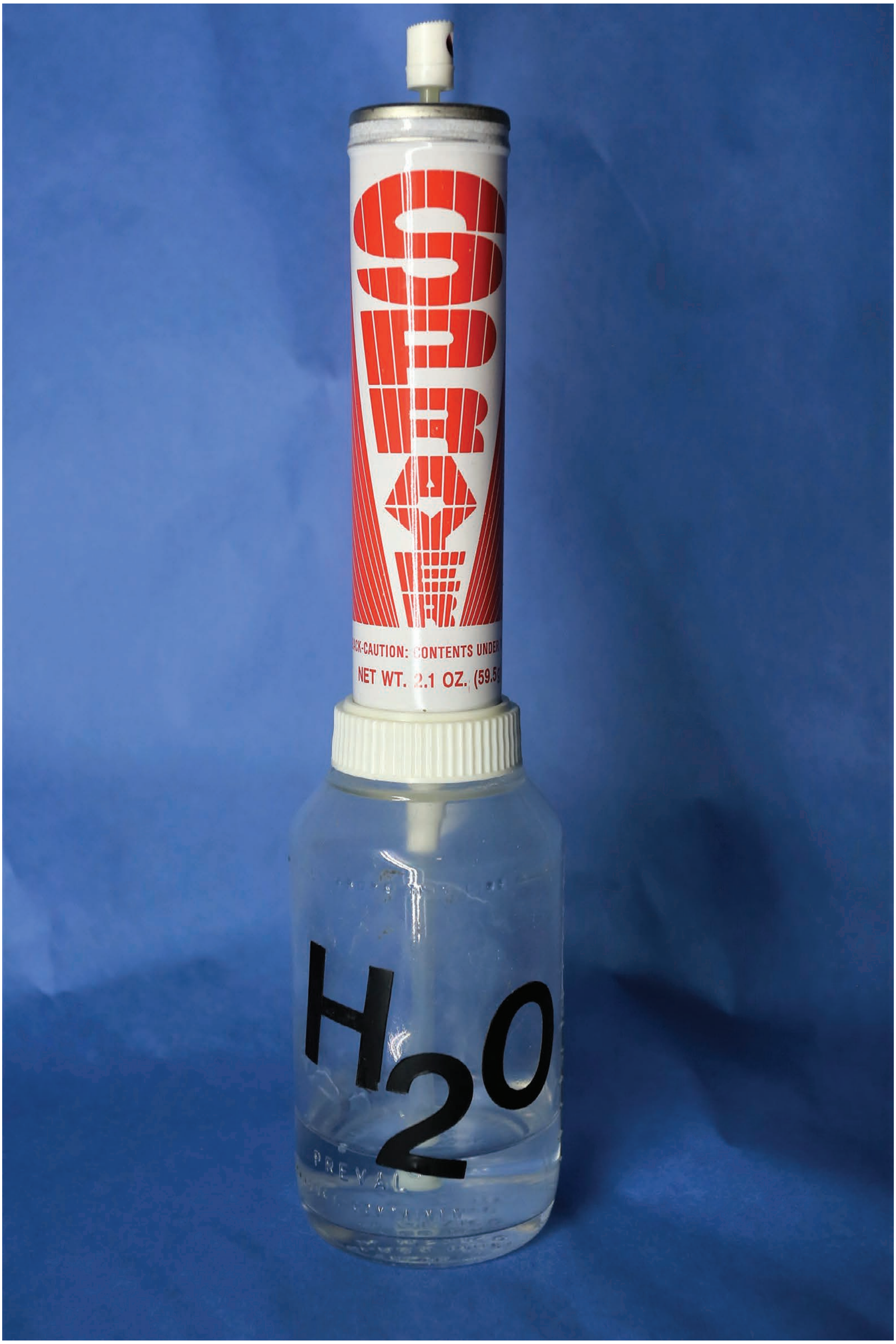

PEEL HERE
SolonCare
Sterile Cotton Tipped Applicators
Item 56800
DISPOSABLE
STERILE in unopened, undamaged package.
LATEX FREE
USA

Figure 7.1 Sterile cotton-tipped swabs are typically packaged as pairs within a paper sleeve envelope.

from the box or bag of swabs. Investigators do not want to introduce any potential cross-contamination. Second, store-bought swabs will typically have two cotton ends, one on each side of the applicator wand. One of these ends should be cut off so that the laboratory is not trying to guess which end they should process. All the swabs should be prepared (cut) before the collection of evidence so that the possibility of cross-contamination is limited. Remember, this is just in cases when the individually packaged swabs are not available.

Distilled water is generally used to “moisten” the swabs when collecting DNA evidence. Some laboratories will request that a saline solution be used, but for the vast majority of crime scene investigators, distilled water is the primary method used to moisten swabs. Swabs are moistened but are not saturated, dunked, or soaked. Investigators do not want to dunk their swabs into the container of distilled water, because that may introduce a cross-contamination potential. There are a couple of easy methods to moisten the swabs. The first is to use a spray atomizer (Figure 7.2). Another method is to simply use an eyedropper to drip a drop of water onto each swab prior to collecting the DNA sample. Whether using distilled water or a saline-type solution, the goal is to lightly moisten the swabs and not saturate them.

DNA evidence swabs should be allowed to air dry before being packaged. It is not acceptable or even feasible for investigators to stand around and wave the evidence swabs in the air waiting for them to dry after collection. Evidence technicians can build a simple drying rack for evidence swabs by drilling 1/8" holes into a length of 2" × 4" wood (Figure 7.3). The holes can be drilled in pairs close together, but some distance should be placed between pairs of swab holders in order to prevent accidental touching and cross-contamination. The length and thickness of wood are not critical, as long as it has enough


CAUTION: CONTENTS UNDER
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H2O
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Figure 7.2 A spray atomizer attached to a container containing distilled water will moisten swabs, without a great risk of saturating them or causing cross-contamination.

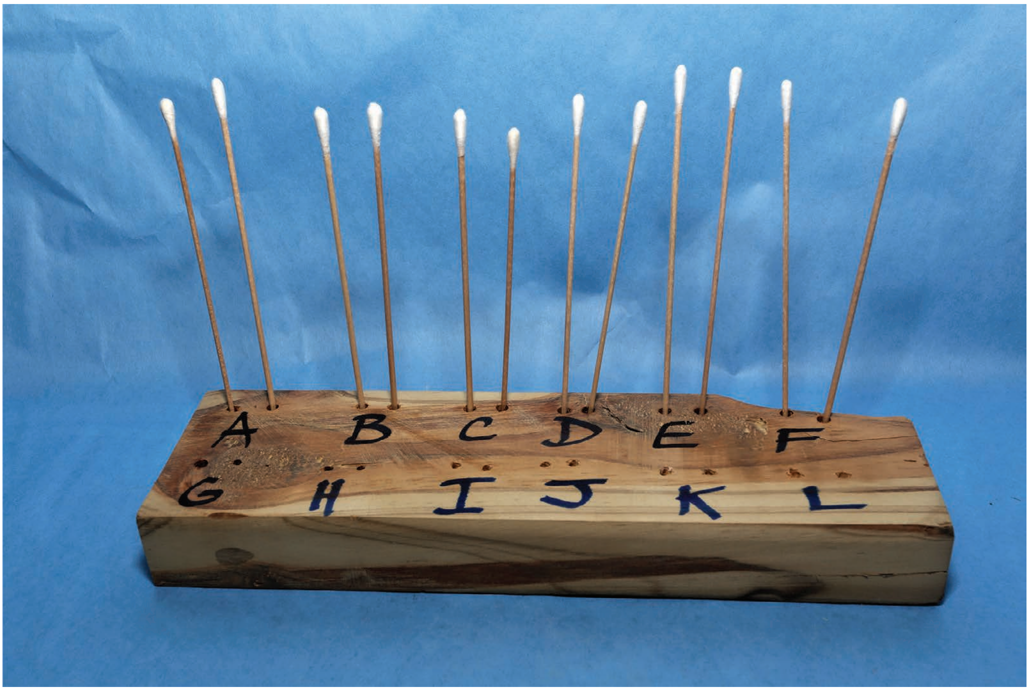


Figure 7.3 DNA evidence swabs should be allowed to air dry prior to packaging. A drying board similar to the one seen in this image allows the swabs to air dry without the risk of contamination. The drying board is easily created by drilling small holes into a piece of 2" × 4" and marking the pairs of holes with letters or numbers.

room to hold a decent volume of swabs. One never knows when a vehicle used in a murder has 20 open beer bottles inside the passenger compartment and the scene investigator wants every bottle fingerprinted and swabbed for DNA evidence. The board can be labeled with standard areas on a vehicle from where evidence swabs are collected: steering wheel, driver controls, radio controls, driver's exterior door handle, driver's interior door handle, etc. Even if the areas of the vehicle are not labeled on the drying board, each pair of holes for the swab applicators should at least be labeled 1, 2, 3 or A, B, C. The investigator can keep a record in their scene notes of what number or letter associates with what part of the vehicle or object swabbed.

The swabbing process itself is not difficult, but some laboratories may have some preferences on how exactly they want their DNA swabbing samples collected and packaged. Once again, communication between those in the field and those in the laboratory is vital to obtaining the best results. Deciding on what parts of the vehicle to swab should be a collaboration between the case investigator and the evidence technician. The job is made much easier if the person completing the vehicle's processing knows how the vehicle was used in the crime and how many suspects were involved in the case. If that communication is not there, the evidence technician may be wasting their time collecting unnecessary DNA samples. Obviously, the search for blood and other body fluids is not as difficult as searching a vehicle for the epithelial cells of Touch DNA. Blood and other body fluids like semen will be discussed later, but what immediately follows is more directed toward the search for microscopic epithelial cells. More often than not, the driver's compartment of the vehicle is going to be a primary focus. Therefore, typical requests for DNA samples will be asked for from the steering wheel, interior and exterior door handles, driver controls like the gear shift, radio, and atmosphere controls. Again, exactly what surfaces on the car are chosen for processing will depend on what is known about the crime.

Each individual surface should get its own pair of swabs for processing. Therefore, one pair of swabs for the door handle, one pair of swabs for the air-conditioning controls, etc. However, there is an obvious size difference between a door handle and a large surface such as a steering wheel. The question begs to be asked, do more than one pair of swabs need to be used on a steering wheel versus a door handle? Basically, that decision is up to the individual processing the vehicle. Some laboratories prefer just one set of swabs per surface, regardless of the size. However, if the evidence technician does decide to break up a swabbing collection on a larger surface item, cut the item in half for collection purposes. For example, on a steering wheel, one can swab the top half of the steering wheel with one pair of swabs and the bottom half with the second pair. Or the investigator could swab the interior surfaces of the steering wheel with one pair of swabs and the outer ring of the steering wheel with a second pair. It is not always necessary to only use one set of swabs across an entire surface. There is one exception to that guideline and that is in reference to “Wet” and “Dry” swabbing samples. Wet and dry swabbing samples will be discussed shortly.

While examining a vehicle for fingerprints, investigators will oftentimes find smudged fingerprints on a key location on the vehicle. In those cases, it is an excellent idea to mark and collect those useless fingerprints void of any ridge detail as potential Touch DNA evidence (Figure 7.4). Swabbing areas touched by a suspect wearing gloves is also a recommended

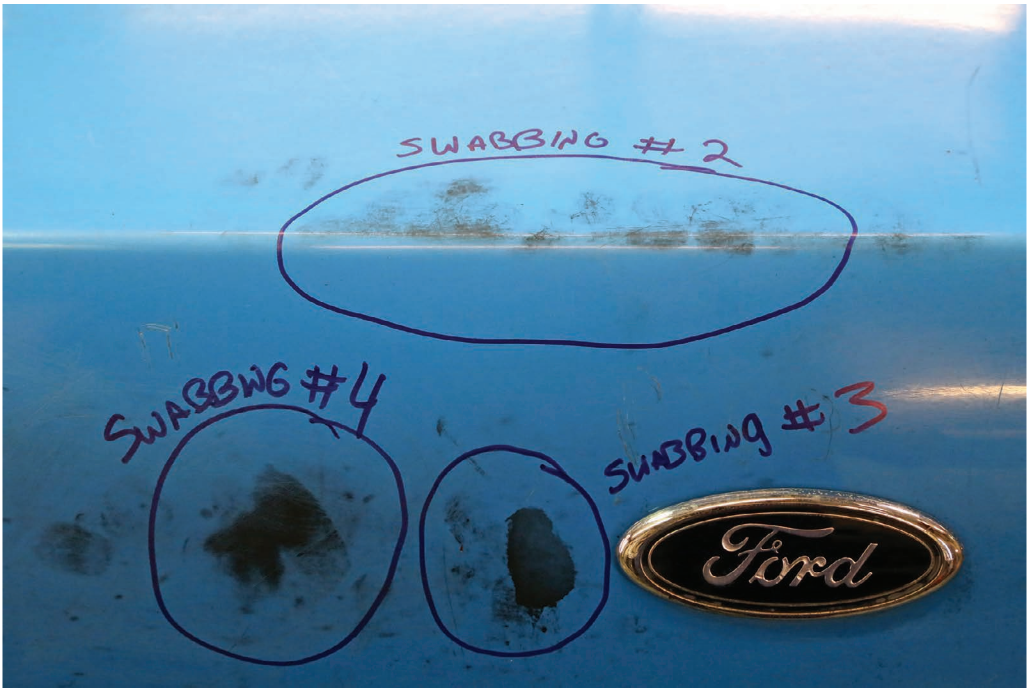


Figure 7.4 Fingerprint smudges found on the trunk of this car were of no value as fingerprint evidence, but they can still be excellent sources of Touch DNA evidence.

practice. Gloves may prevent the transfer of fingerprints onto a surface, but they can still transfer DNA evidence. In addition to processing the vehicle itself, investigators have to decide what useful items inside the car are worth processing for DNA evidence. This is where the investigator should use the case information and what they see on and in the vehicle to make an informed decision about what to examine inside the vehicle. For example, an empty soda can on the rear floorboard probably does not have the evidentiary value that a partially finished beer bottle has that is resting in the center console. Items of contraband, such as weapons and narcotics, probably should be swabbed for Touch DNA. It bears repeating that investigators should always keep in mind the basic rule of thumb that it is better to have the item (DNA evidence in this case) and not need it, than not have the item and need it.

When the investigator has identified the places that they wish to swab for DNA, blood, semen, touch, etc., then they begin by opening the paper packaging holding the pair of sterile swabs. Do not just shred the packaging, because the packaging may be used again. Many of the prepackaged swabs have an easy tab at one end that allows for the two sides of the packaging to peel apart. The side that peels apart will be the side containing the applicator wands so that the technician is not grabbing the cotton end of the swabs. If the particular packaging being used does not have this convenient opening feature, then ensure that when the packaging is torn open, that it is opened from the applicator end and not the cotton-tip end.

The swabs are then moistened with distilled water. Water should be applied to the swabs instead of the swabs being placed into the source of water. The moistened cotton fibers will be used to trap the DNA for later extraction by the laboratory. The swabs are then rubbed and rotated across the surface being examined (Figure 7.5). The entire swab

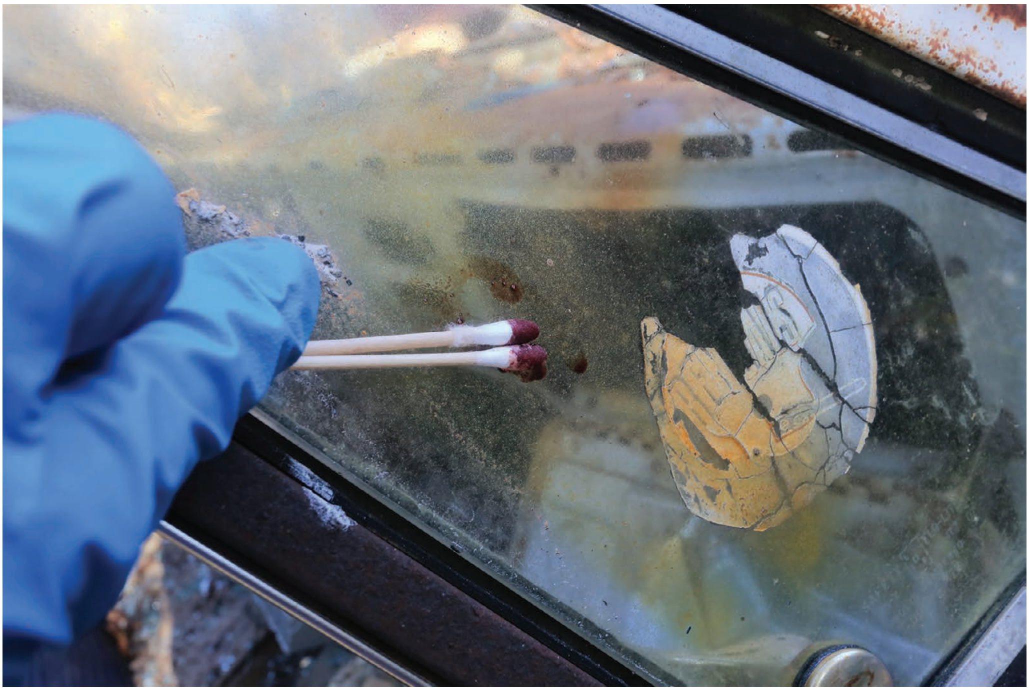


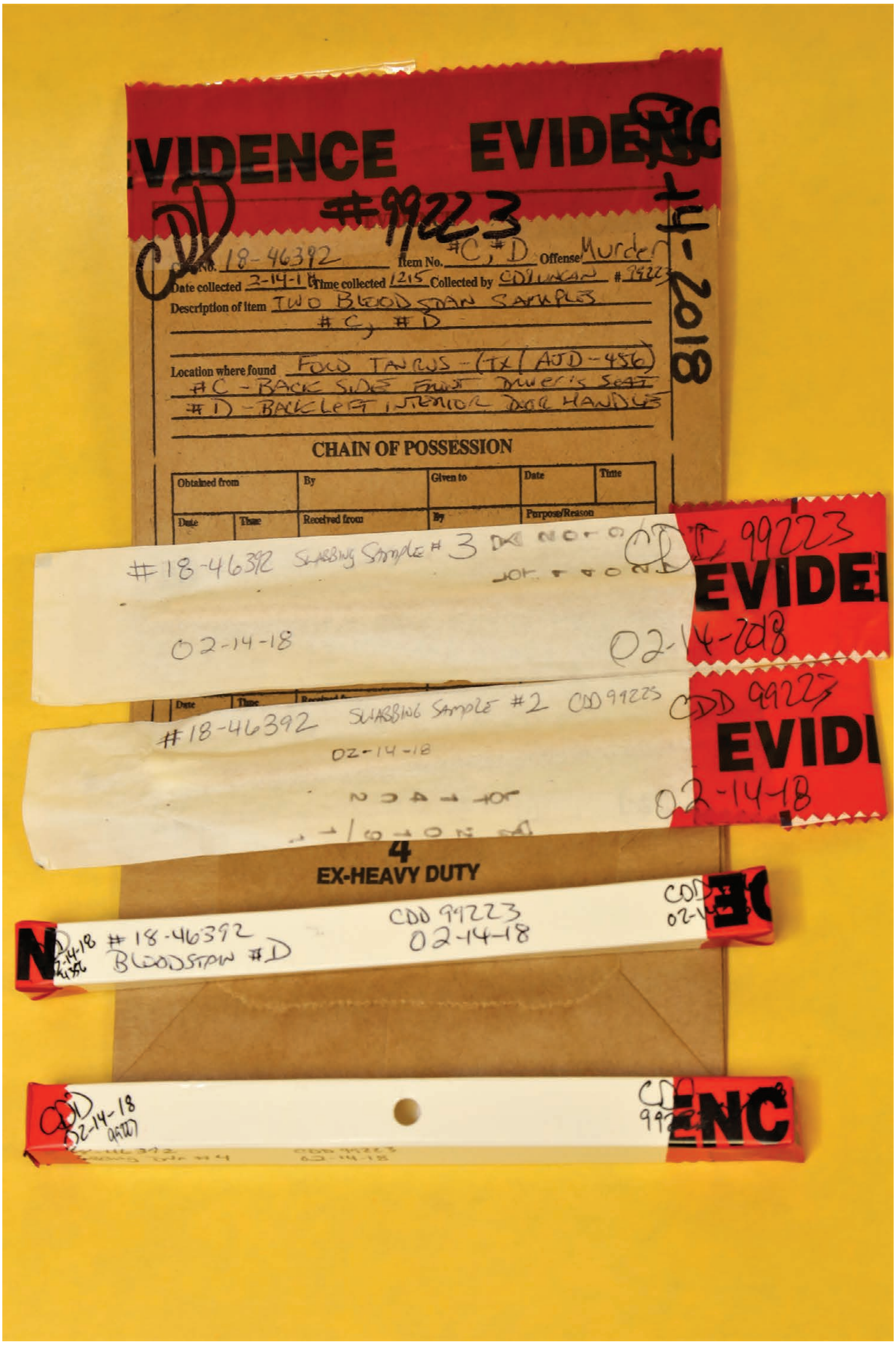
Figure 7.5 Rub, rotate, and spin the swabs across the surface being examined, even when collecting Touch DNA, which is frequently unseen, unlike the blood visible in this photograph.

should be used to collect as much potential DNA as possible. The swabs should be firmly pressed on the surface, but not so hard as to break the applicator wands. For Touch DNA evidence, the entire surface of the vehicle part or object should be swabbed. For visible DNA evidence collection, if the stain is small, then the entire stain should be collected. Otherwise, the two swabs should be fully coated in the stain's substance. The pair of swabs are then placed aside temporarily, preferably in a drying stand, so that they may air dry before final packaging. As the swabs are drying, the investigator can continue around the vehicle and collect the remaining swabbing samples. It is extremely important that the investigator makes clear notes as to which swabs match with what surface area.

Some agencies prefer two swabbings for every surface: one "wet" swabbing and one "dry." The wet swabbing is completed just as described and the dry swabbing is simply a re-swabbing of the same surface, but with a pair of dry (non-moistened) swabs. Investigators should be sure to mark the evidence packaging as "wet" and "dry" samples, because the laboratory may have a preference of testing the "wet" sample first, prior to the "dry" sample. Even if an agency's protocols do not require a dry swabbing, if an investigator notices a significant wet residue left behind on a surface because they placed too much distilled water on their swabs, re-swabbing the area with a dry pair of swabs would be an excellent suggestion. Either way, make sure the evidence packaging is clearly marked as a wet or dry swabbing sample.

Next, the investigator can take the empty swab packages and record the case information on each of the packages used. Some laboratories prefer that "swab boxes" are used instead of the original swab envelopes. Swab boxes are designed to hold two individual swabs from single DNA or other swabbing samples. Swab boxes come from the forensic supply companies flat and must be folded to make the box shape. It is easier to document the case information on the boxes when they are flat rather than after they have been formed into boxes. Remember, all levels of evidence packaging require that all pertinent case information be written on it. This is to protect evidence in case it becomes inadvertently separated from any outer packaging. The case information, at the very least, should include the case number, the date of collection, the technician's name and identification or unit number, and the specific location where the swabbing sample was recovered from. If a particular agency requires more or less information, then certainly follow the agency's protocols. However, having more information on the packaging or in a report than is necessary is never wrong. Once the swabs are dry, they can be removed from the drying board and placed into their original packaging that has now been marked with the case information. It is a good idea to seal the end of the envelope or both ends of the swab box with evidence tape (Figure 7.6). Remember to initial the evidence tape and ensure that the initials are written on both the tape and the packaging.

All biological evidence is packaged in paper containers. Paper containers include cardboard boxes, different types of envelopes, and paper evidence bags. Biological evidence is never packaged inside a plastic container. The container must be breathable so that evidence does not putrefy and degrade. The individual swabbing samples are already separated into their individual paper envelopes or boxes. The next step is to place them into a more durable container, whether that be a larger envelope or a cardboard box. The outer container should be large enough that the evidence is not crushed or squeezed inside, but small enough that the evidence does not slide around too much inside the larger container. It is better to be too big, rather than too small. If the box is too large, one can ball up some butcher paper and create some buffer inside the box so that the evidence is better secured



EVIDENCE EVIDENCE

#99223

CDD

2-14-2018

Case No. 18-46392 Item No. #C, #D Offense Murder

Date collected 2-14-18 Time collected 1215 Collected by CD DUNCAN #99223

Description of item TWO BLOOD STAIN SAMPLES
#C, #D

Location where found FORD TAURUS - (TX) AJD-456
#C - BACK SIDE FRONT DRIVER'S SEAT
#D - BACK LEFT INTERIOR DOOR HANDLE

CHAIN OF POSSESSION

Obtained from	By	Given to	Date	Time
Date / Time	Received from	By	Purpose/Reason	

#18-46392 SWABBING Sample #3
02-14-18
CDD 99223 EVIDENCE 02-14-2018

#18-46392 SWABBING SAMPLE #2 CDD 99225
02-14-18
CDD 99223 EVIDENCE 02-14-18

4
EX-HEAVY DUTY

#18-46392 BLOODSTAIN #D
CDD 99223 02-14-18

CDD 02-14-18 99223

Figure 7.6 Every level of packaging should be identifiable by all the pertinent case information. All evidence tape seals should be initialed or otherwise marked so that the written information rests on the evidence tape as well as the packaging itself. Notice the two types of packaging, the paper sleeves that were the original swab packages and the other is a box container designed for swabbing samples.

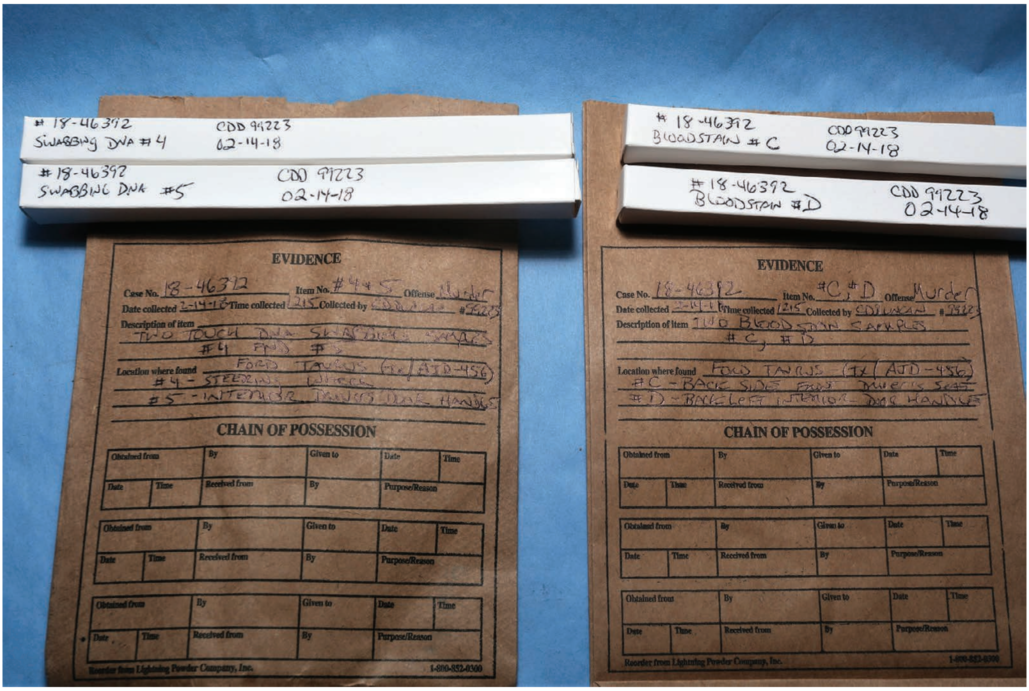

# 18-46392
SWABBING DNA # 4
CDD 99223
02-14-18
# 18-46392
SWABBING DNA #5
CDD 99223
02-14-18
# 18-46392
BLOODSTAIN # C
CDD 99223
02-14-18
# 18-46392
BLOODSTAIN #D
CDD 99223
02-14-18
EVIDENCE
CHAIN OF POSSESSION
EVIDENCE
CHAIN OF POSSESSION

Figure 7.7 Like or similar evidence from the same source can be packaged together. However, different forms or types of evidence should be separated. In this photograph, the two Touch DNA swabbing samples are packaged together, while the two bloodstain samples are packaged together, but separated from each other by placing them in their own outer packaging (paper bags).

from rolling around. Similar items of evidence can be packaged together. Touch DNA evidence, even from different surfaces, can all be packaged together in the larger container, as long as the samples are individually separated into their own paper sleeves or swab boxes. However, blood evidence should be separated from Touch DNA evidence and should be kept away from other types of biological evidence (Figure 7.7). All outer containers should be sealed with packing tape and not just "evidence" tape. Evidence tape is simply tamper-resistant tape and will not secure containers from rough handling. Some agencies may have protocols that stipulate that every seam on a box or envelope must be covered with packing tape and/or tamper-resistant tape. Please follow all agency policies and procedures.

Scraping

The scraping technique is not utilized very often, but there are a couple of scenarios that it may come into use and be an easier way of collecting DNA evidence. There are a couple of tools needed for this technique. One will need a scalpel and sterile blade and a druggist-fold envelope. The druggist-fold envelope is a standard sheet of clean printer paper that is folded in half, once along the long edge and once along the short edge. This two-fold procedure creates a small pocket (envelope) and allows one to catch the scraped-off material from the vehicle. One can also use a glassine envelope to catch any material scraped off a car, but the opening is smaller than a druggist-fold envelope and, therefore, may be a challenge to catch any flaked-off material. Before collecting the sample, the case information should be documented on the outside of the druggist-fold envelope. It is always easier to write on collection envelopes before they are filled with evidence. The scraping technique involves using the sterile blade and scraping or slicing off a visible piece of evidence from the vehicle (Figure 7.8). The investigator can hold

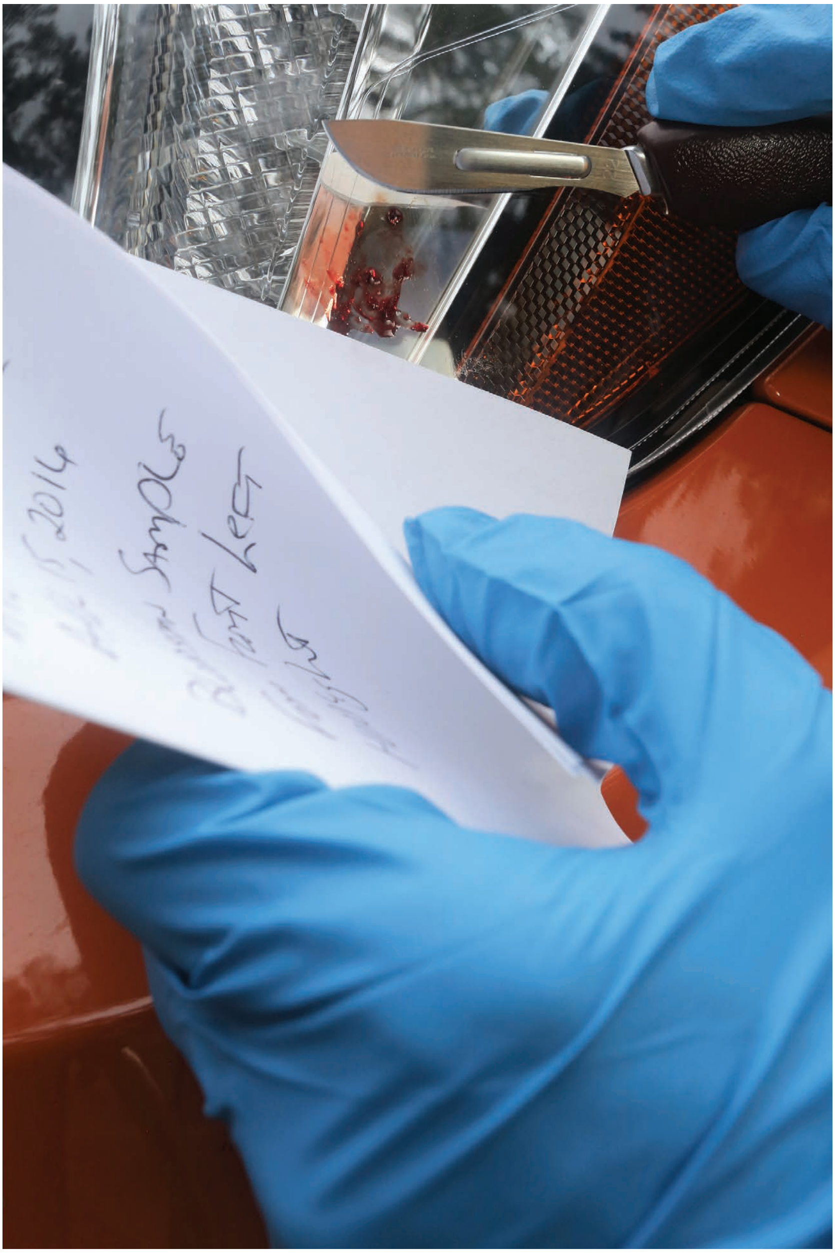


Figure 7.8 The scraping technique involves holding an open druggist-fold envelope below the biological material and using a sterile scalpel or blade to slice the material off the vehicle and have it fall into the druggist-fold envelope.

the open druggist-fold envelope below the biological material wishing to be collected. The investigator then scrapes or slices off the material from the car and catches it in the druggist-fold envelope. The envelope can then be sealed on the two open sides with evidence or tamper-resistant tape. Do not forget to initial or sign across the tape and the envelope.

The scraping technique is not frequently used for biological material, but it can be. The scraping technique is much more common when collecting paint and paint-transfer samples from vehicles. The scraping technique can be used on visible sources of biological sources, such as blood and tissue. This technique is clearly not appropriate for collecting Touch DNA samples. When blood drops land on a vehicle's hot surface, they can dry very quickly and as a result, their consistency becomes flakey. This flakey material can be a bit of a challenge to collect with a moistened swab. Scraping these stains can be a better alternative. One word of warning about bloodstains that have this flakey texture or consistency and that is these bloodstains are extremely fragile and will crumble and float away with any wind current. Therefore, if the bloodstained vehicle is in the field and being towed back to a vehicle examination facility for processing, the chances are that the flakey bloodstains will be gone by the time the vehicle reaches the processing facility. Always try and collect these fragile bloodstains prior to moving the vehicle. In addition, the evidence technicians should be careful of ambient wind conditions, because even a moderate breeze can cause the scraped bloodstain to blow away instead of falling into the druggist-fold envelope.

Another type of biological material that might be scraped off a vehicle is tissue. Tissue left behind on a vehicle in hit and run investigations is a common occurrence. Human tissue can be quite rubbery and sticky. It can certainly be swabbed, but in order to ensure the collection of enough genetic material, scraping the entire substance into a druggist-fold envelope might be the better alternative. In hit and run investigations, evidence technicians need to look for human tissue in the lower recesses of a vehicle, including the wheel wells and underside of a vehicle, as well as anywhere else a person may have been struck by the vehicle. Scraping the tissue from these areas will ensure that enough biological material is gathered to ensure a full genetic profile can be extracted by the laboratory.

Tape Lifting

The tape-lifting technique is just what it sounds like. It involves the recovery of evidence with tape. However, tape is not the only possible tool. Crime scene and forensic supply companies offer a host of evidence-lifting products. In addition to packaging tape, some of these devices include the following:

- Gel-print lifting pads
- Hinge-lifting pads
- Tape-lifting rollers
- Evidence vacuums

These specialty tools do have their uses, but there is nothing wrong with simply using packing tape or the 4"-wide fingerprint tape that is likely already in a crime scene investigator's tool kit. Once again, communication with the evidence technician's laboratory on which method or tool the laboratory prefers is recommended. The laboratory may prefer one method over another and to ensure the best quality outcome, investigators should always defer to the laboratory personnel's wishes.

Tape lifts are typically used in the recovery of hairs and fibers. Of course, hair can be a source of DNA evidence. Mitochondrial DNA, which is inherited solely through maternal lines, can be recovered from a hair's shaft. Nuclear DNA can be found in the tissue bulb found at the end of hair follicles. Tape lifts are not exclusively used for just hairs and fibers. Tape lifts can also be used to lift dried bloodstains from a vehicle's surface. Tape lifting-dried bloodstains may not be the technique of preference, but it is possible. One example of when it may be advantageous is when someone leaves a bloodstained footprint or handprint on a vehicle and one way to collect it is through a tape lift. Photographing the bloodstained impression and swabbing the bloodstain is also acceptable, but a lifted bloodstained impression does make a nice piece of demonstrable evidence in court.

Bloodstains aside, tape lifts are typically reserved for hair and fiber evidence. This could be on the outside of a vehicle in the case of a vehicle-pedestrian accident, but more commonly completed on the vehicle's interior and more specifically, the vehicle's seats. Choosing the right lifting medium for the job is a choice for the investigator, with input from the laboratory. The Law of Superposition says that the most recent deposits on a surface will be those found on top. This rule should be kept in mind when using collection tools like evidence vacuums. The evidence vacuums suck up everything, absolutely everything from the top of the surface to the stuff pressed deep down inside the nooks and crannies of a surface being examined. In addition, the vacuum will swirl and mix up all that material. Thereby, the investigation loses any potential timeline value. Consequently, the evidence vacuums should be an evidence technician's last option. Evidence vacuums can be utilized after any tape lifting efforts.

Because of the Law of Superposition, one of the first methods of recovering hairs and fibers can be to simply pick up visible hairs with one's fingers or tweezers. If there are only a few strands of hairs or fibers visible on the surface, then it might be prudent to simply collect them individually and place them into an evidence envelope or glassine envelope. Glassine envelopes are recommended because they are breathable, which is important for biological evidence, but also because they resist static electricity. This is especially beneficial when packaging hair evidence because static electricity can make it quite difficult placing or removing hair and fiber evidence from standard paper envelopes.

Crime scene supply companies offer for sale gel-lifting pads and hinge-style lifting pads. These are similar lifting devices used in latent fingerprint lifting endeavors. The same pads used to lift latent fingerprints can be used to lift hair and fiber evidence off a vehicle's surface. They do have a small advantage over tape lifting methods. The gel and hinge-style lifters have a cellophane cover that can be placed over the evidence attached to the sticky part of the lifter. The gel-lifting pads are used by simply pressing them down on the surface needing processing, running your hand firmly over the back, and pulling them up. The pads can be placed down several times onto the surface. However, when the investigator feels a lack of resistance from the sticky gel as it is pulled off the surface, then they should stop using the lifter and start with a new gel-lifting pad. Once a lifting pad has been used, the evidence technician should mark on the pad where exactly that particular pad was utilized. Eventually, all the case information will be marked on the gel-lifting pad, but that can be done later, after the entire surface has been completed. The final step, after all the gel pads have been marked with the case information, is to package them together in a larger evidence envelope or cardboard box. Forensic supply companies will also sell tape rollers, similar to a lint roller one would use to remove cat and dog hair from clothing. These tape rollers are just like clothing lint rollers. They are rolled back and forth across a surface, thereby picking up small hairs and fibers. The removable tape used to collect the hairs and fibers can be peeled off the roller, marked with the case information, and placed into a paper envelope for submission into evidence. As one piece of tape is pulled from the tape roller, another will be exposed and can be used to recover any remaining hairs and fibers.

Crime scene investigators can certainly use any of these products and they work exceptionally well. However, they do not necessarily work any better than plain old fingerprint tape (4" wide is preferable) or packing tape. If one's laboratory prefers another medium for collection samples, then of course, use those. However, not every agency or investigator has the resources of larger more well-equipped crime scene units and forensic laboratories. In those cases, packing and fingerprint tapes are excellent alternatives. Before the technician begins the lifting process, they need to retrieve a large, plastic, Ziplock evidence bag. With a clean knife or scissors, cut the bag down two of its three sealed edges and open the bag up flat. Mark the opened bag with the case information using a permanent marker. Cover the information with cellophane tape to prevent the information from being inadvertently wiped away. Place the bag to the side for a moment. The tape lifts will eventually be placed on the cut-open bag. After the evidence bag has been readied, the investigator should pull off a strip of tape and do not forget to dogear the end of the tape left on the roll. It does not matter which type of tape is chosen. The decision is up to the evidence technician. The length of tape taken off the roll should not be longer than the length of the evidence bag since that will be where it will be eventually laid down or applied. The next step is to lay the tape across the surface of the vehicle or interior and smooth out the tape firmly with a gloved hand (Figure 7.9). Repeat this process until the entire surface needing processing is complete. Interior surfaces, especially cloth surfaces, may require more than one application of the tape onto an area. Exterior, leather, and other hard surfaces are generally processed with a single pass of the tape. However, it is always a good idea to overlay your tape applications so that nothing is missed. When the tape starts to lose its tackiness, then it should be laid down onto the cut-open evidence bag (Figure 7.10). A new strip of tape is removed from the roll and the evidence collection process continues. Although the hairs and fibers would probably not putrefy like blood evidence would in a plastic container, it is always best to place all biological evidence inside a paper container.

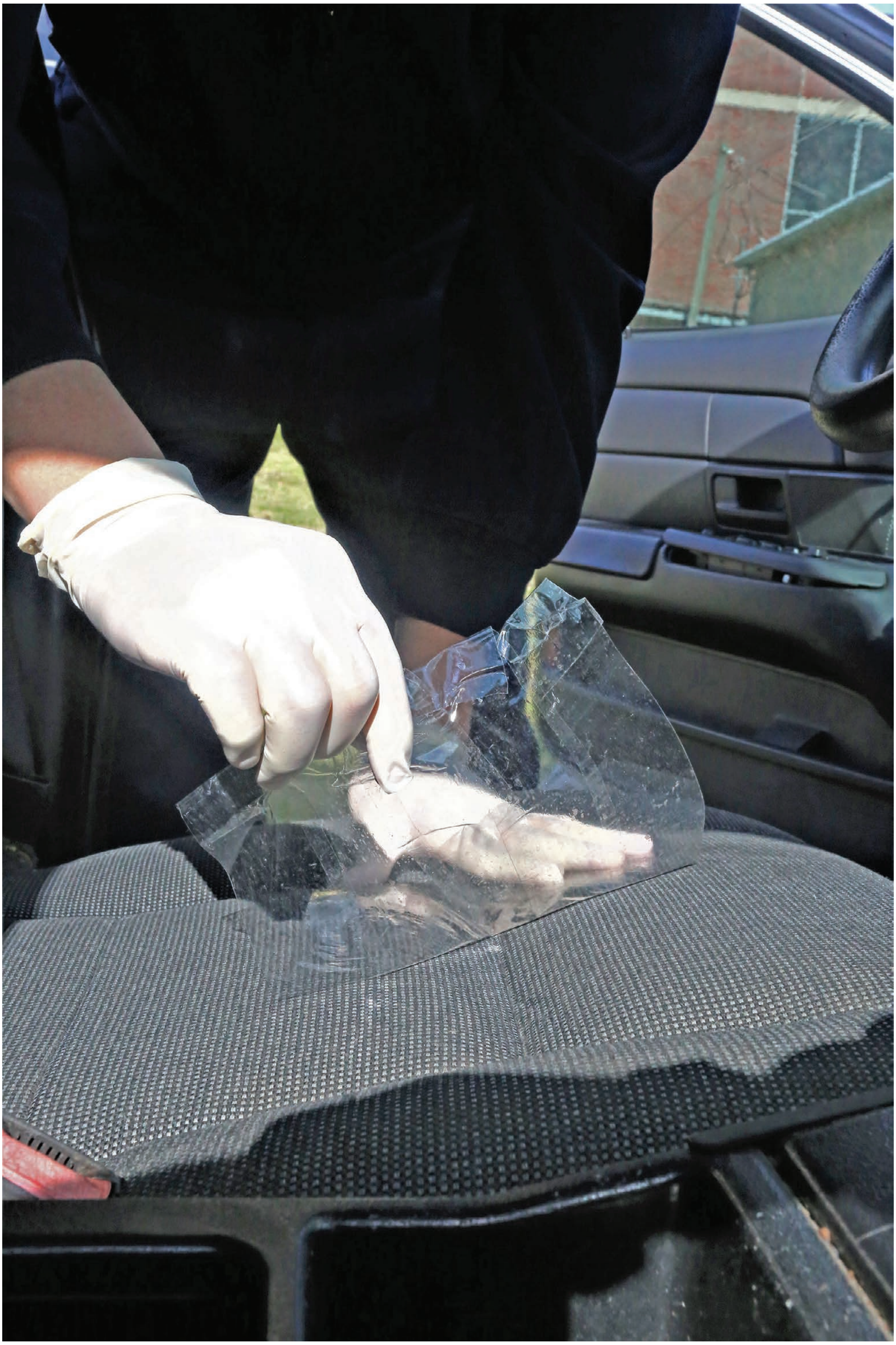


Figure 7.9 Tape lifts are a way to recover hairs and fibers from surfaces on and inside the vehicle. The tape is laid across the surface and pressed down with a gloved hand. This process is repeated until the entire surface area is covered.

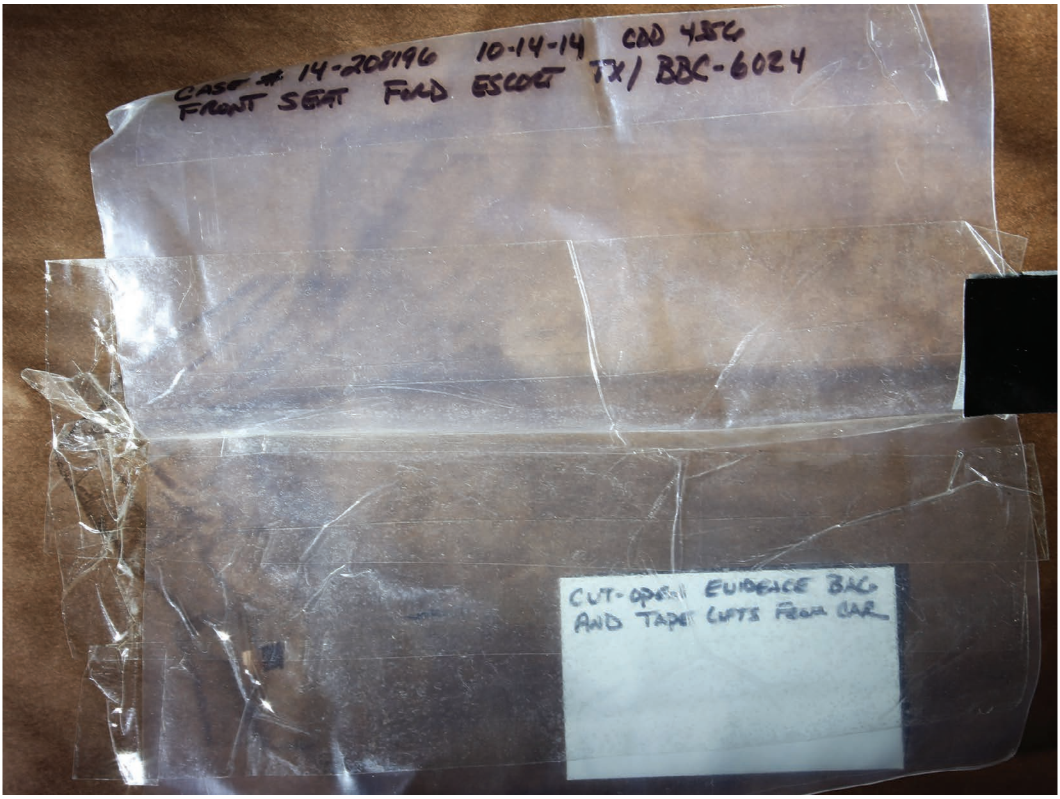

CASE # 14-208196 10-14-14 CDD 4356
FRONT SEAT FORD ESCORT TX/ BBC-6024
CUT-OPEN EVIDENCE BAG
AND TAPE LIFTS FROM CAR

Figure 7.10 Multiple strips of packing tape are laid across a cut-open evidence bag in order to preserve the evidence. The plastic evidence bag is marked with the case information, as well as the paper evidence container it is ultimately placed into for laboratory submission.

Cutting

Sometimes the exact location of biological evidence is unclear. A mist bloodstain pattern or traces of semen can be problematic because of their visibility. An alternative to swabbing for such evidence blindly is to cut the surface out of the car. This cutting technique is generally restricted to interior surfaces, such as car seats and floorboard coverings [Figure 7.11(a) and (b)]. The one guiding principle when cutting out portions of the car is to take more than one thinks they need. For example, say there is a possible 1" diameter semen stain on the top of the seat. Do not be afraid to cut a 6" diameter hole around stain. This will ensure that the entire stain or substance is recovered and gives space to the technician and laboratory personnel to handle the evidence without disturbing the biological part of the evidence. Cutting material out of a vehicle is best completed with a sterile surgical blade. At the very least an evidence processor should wipe down any other cutting implement with isopropyl alcohol. Like other biological evidence, the cuttings should be packaged in paper containers, envelopes, or cardboard boxes, marked with the case information and submitted into evidence.

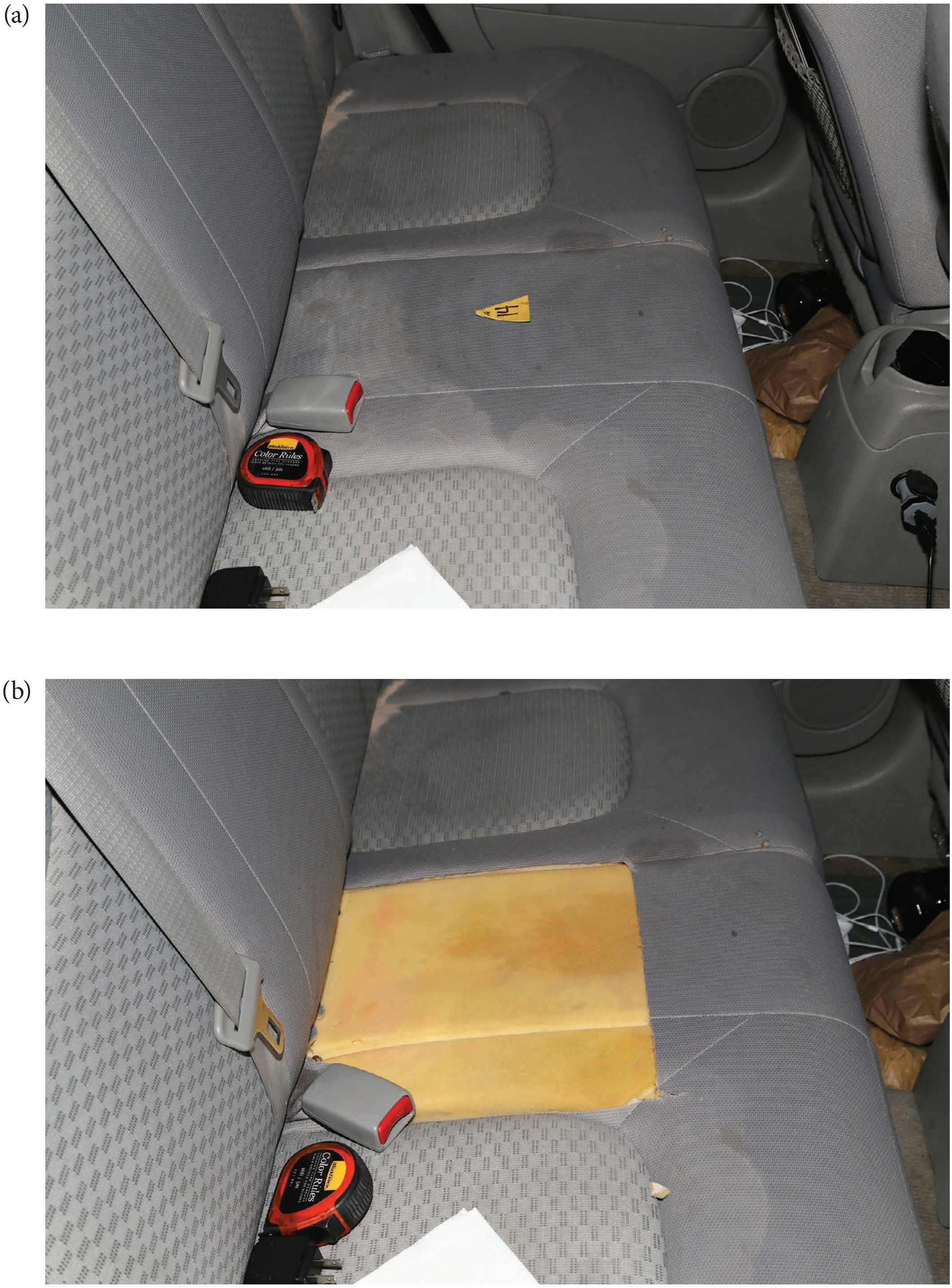


Figure 7.11 (a) An unknown stain was detected with an alternate light source on the back seat of this vehicle that was being searched regarding a sexual assault. (b) The stain was small, but notice how large the cutting was. It is always better to cut out extra material rather than leave behind any possible DNA evidence.

Collecting (the Whole Object)

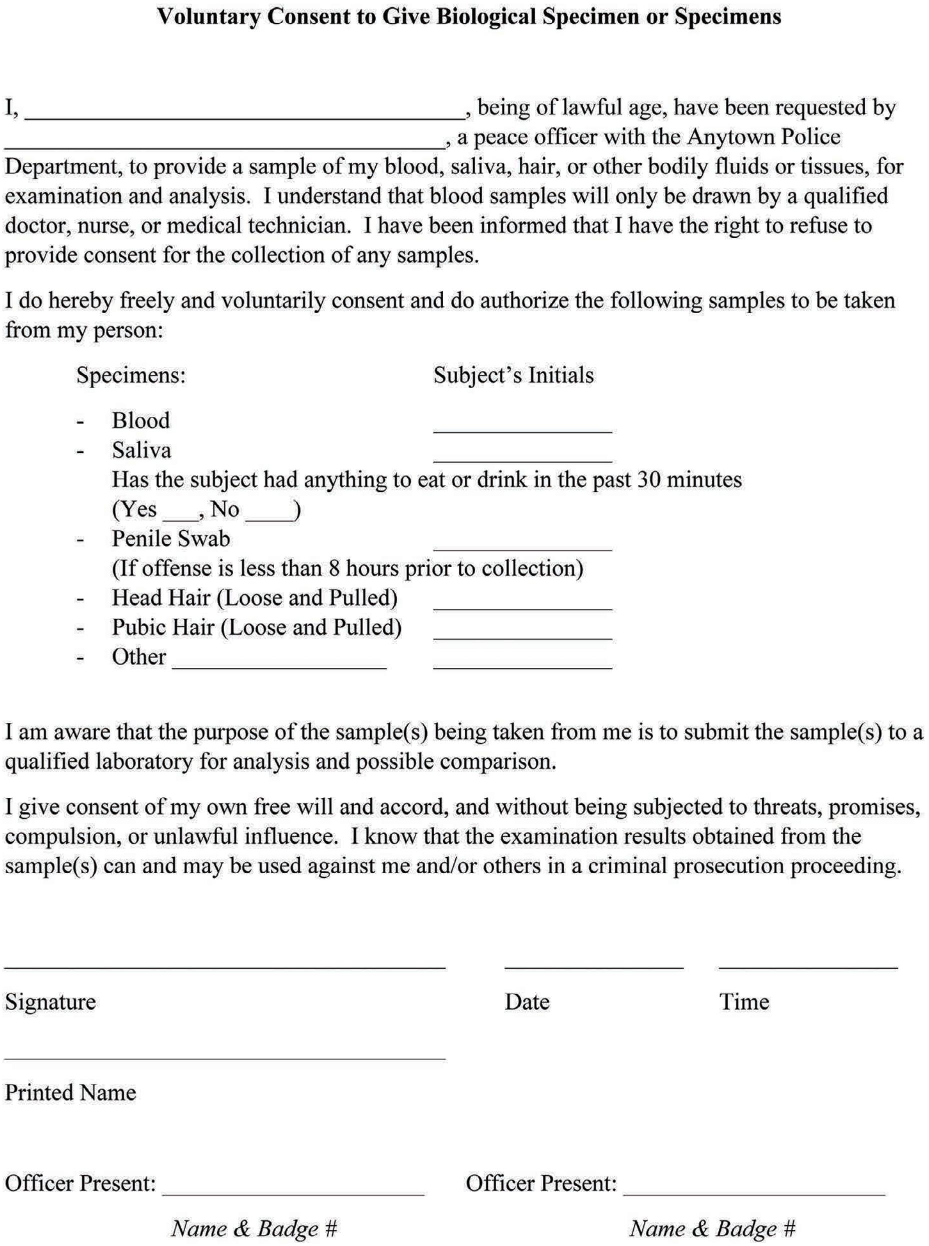
The final method or technique in recovering biological evidence from a vehicle is simply to take the entire object. This technique is mostly in reference to articles found inside the car, but could apply to parts of the vehicle as well. Evidence technicians need to evaluate the size of the object and the ease at which the object could be cut up or processed in some other way. For example, if a potential semen stain was found on a washcloth, it would be better to simply take the entire washcloth. If a potential semen stain was found on a car seat, it would be better to cut the cover off the seat rather than submit the whole car seat into evidence.

On occasion, it may be necessary to take off a part of a car as evidence. For example, hit and run investigations will leave all types of pattern transfer evidence, as well as biological evidence, on the front of a motor vehicle. Transfer patterns found at impact points on something as big as a bumper or as small as a headlight assembly can be of demonstrable value in court. In addition, the biological evidence that is found at these impact sites will also be of evidentiary importance. On occasion, an investigator may have to decide what is more important, impression evidence or biological evidence. The recovery of the biological evidence may cause the impression evidence to be destroyed. In these types of cases, the item should be recovered as a whole. As the investigation progresses, the case investigator can decide which is more important and move on from there. As a rule of thumb, when in doubt, just collect the whole item.

Collecting Known DNA Samples from Victims and Complainants

Case investigators and laboratory personnel will appreciate a crime scene investigator's extra effort in cases involving DNA evidence. One of the more appreciated things an investigator can do that is not directly related to a vehicle's processing is to collect known samples of DNA from complainants and victims. The medical examiner or pathologist will naturally collect DNA samples from murder victims, but less serious offenses are still benefitted by the collection of known DNA samples. DNA samples can be collected at the scene of the crime, but in those cases where a car may have been stolen and used in a more serious crime, a DNA sample was likely not collected by the officer taking the stolen vehicle report. Whatever the cause, when the complainant arrives to pick up their vehicle, whether it was processed in the field or processed at a vehicle examination facility, the evidence technician might consider asking for a DNA sample from the person.

Known DNA samples are also known as Buccal swab samples. Buccal refers to the molar cavity inside the mouth and a buccal swab sample is a swabbing sample collected by scraping the inside of a person's mouth with a pair of swabs. Before collecting a buccal swab sample from a complainant, it is a good idea to obtain a "Consent to Search" specific to DNA samples (Figure 7.12). Complainants and victims typically will not balk at providing a DNA sample, because the procedure does not involve needles or anything painful. Remember that consent forms must be voluntary and not coerced. Investigators cannot make promises, threats, or coercion of any type. Read the consent form to the complainant or have them read it and once the form is signed, then a DNA buccal swab sample can be collected.



Voluntary Consent to Give Biological Specimen or Specimens

I, ____________________________________, being of lawful age, have been requested by ____________________________________, a peace officer with the Anytown Police Department, to provide a sample of my blood, saliva, hair, or other bodily fluids or tissues, for examination and analysis. I understand that blood samples will only be drawn by a qualified doctor, nurse, or medical technician. I have been informed that I have the right to refuse to provide consent for the collection of any samples.

I do hereby freely and voluntarily consent and do authorize the following samples to be taken from my person:

Specimens: Subject's Initials

- Blood _______________
- Saliva _______________
  Has the subject had anything to eat or drink in the past 30 minutes
  (Yes ___, No ____)
- Penile Swab _______________
  (If offense is less than 8 hours prior to collection)
- Head Hair (Loose and Pulled) _______________
- Pubic Hair (Loose and Pulled) _______________
- Other __________________ _______________

I am aware that the purpose of the sample(s) being taken from me is to submit the sample(s) to a qualified laboratory for analysis and possible comparison.

I give consent of my own free will and accord, and without being subjected to threats, promises, compulsion, or unlawful influence. I know that the examination results obtained from the sample(s) can and may be used against me and/or others in a criminal prosecution proceeding.

_____________________________________ _______________ _______________

Signature Date Time

____

Printed Name

Officer Present: ______________________ Officer Present: ______________________

Name & Badge # *Name & Badge #*

Figure 7.12 Consent to searches is a common necessity for crime scene investigators. Collecting known DNA samples from victims and complainants is also a common request. DNA consent to search forms like the one pictured here is slightly different from consent to search for a vehicle or other property.

Buccal swab samples are collected with the same type of swabs used to collect unknown DNA samples from a vehicle's surface. The 6" handles are most beneficial in buccal swab collection, even more than unknown sample collections. Two swabs are used like any other collection. With instructions, the complainant may collect their own DNA sample. The individual slides the two swabs into their mouth and up against one cheek. The swabs

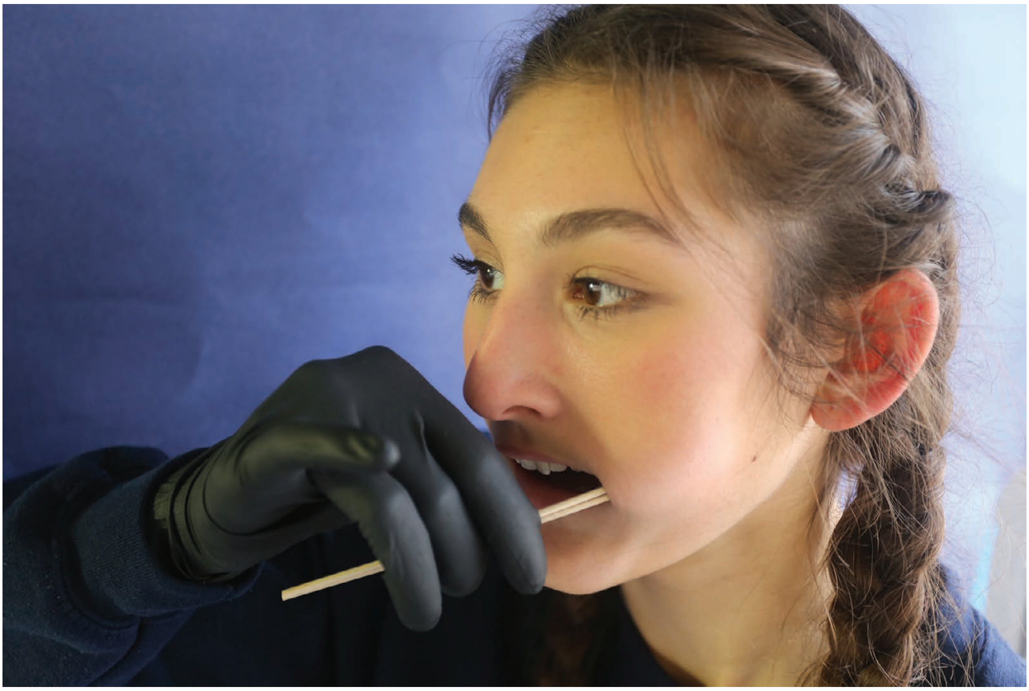


Figure 7.13 One does not need to be gentle when collecting a DNA buccal swab sample from an individual. The goal is to scrape epithelial cells from the inside of the person's cheek. The swabs are soft cotton, so there should be little concern of injury. If the individual is collecting their own DNA sample, the investigator wants to observe the cheek bulging out because of the swabs pressing against the inside of the mouth.

should be rotated and scraped against the inside of the mouth in order to pick up the epithelial cells for approximately 15–20 seconds. The investigator should watch the person and see observable signs that the cheek is moving from the inside and that a proper swabbing collection is occurring. It is not uncommon that suspects who do not want to actually cooperate with law enforcement will simply act as if they were. Suspects may put the swabs inside their mouth and spin the swabs in an open mouth cavity, but will not come close to swabbing the inside of their cheek. This is why it is important to watch *anyone* providing a DNA sample and ensure that they are scraping the inside of their cheek with the swabs. Some victims or complainants may wish that the investigator complete the process. It does not matter as long as the investigator is present and ensures that a proper collection is made (Figure 7.13).

Finding Hidden Sources of DNA Evidence

Blood is a great source of DNA evidence, but criminals have been known to conceal their crimes by wiping down surfaces to destroy any fingerprints and washing blood and DNA evidence out of a vehicle. Visible blood is quite easy to find and recover. However, when the vehicle has been cleaned, the locating of possible blood can be a greater challenge. Fortunately, blood is a fairly resilient substance and it is extremely difficult to remove all traces of blood from a vehicle. This is a positive for crime scene investigators and they have a couple of choices in chemicals to choose from to make hidden blood more visible. Luminol and Bluestar are two of the most common chemiluminescent chemical agents used to search for hidden blood. Luminol has a variety of formulas and is more sensitive to minute traces of blood, as much as one part per 300,000. Bluestar is not quite as sensitive as luminol. Bluestar is sensitive to one part per 10,000. The trade off to the lack of sensitivity compared to luminol is that Bluestar is extremely easy to mix and has a brighter reaction to blood. Luminol is typically prepared from a couple of chemical powders and liquids that need to be mixed slowly and thoroughly. Bluestar comes as a pair of tablets that are placed in a specific volume of distilled water and shaken together until fully dissolved.

Both these chemicals can result in false-positive results. For that reason, investigators need to watch how the reactions develop and make a written record of those observations in their supplement offense report. For example, bleach and items with iron in them will react with both luminol and Bluestar. Investigators are encouraged to practice with their chemical of choice and use it on substances that will result in false-positive results, as well as bloodstained items. Through practice and experience, investigators will be able to judge the reactions for the likelihood that they are actually blood. As an example, bleach reactions develop quicker than blood and are typically a lighter shade of blue than blood. Regardless of how a reaction presents itself, the investigator should still collect swabbing samples of the reacting surface.

Luminol and Bluestar are applied in darkness. Processing of vehicles is best done inside a garage so that the light can be limited and controlled. As a result of the dark environment, the starting point for any chemical enhancement of blood is to gather all chemicals and photographic equipment, and evidence collection tools that will be needed to process the vehicle. Photography of luminol and Bluestar was fully discussed in Chapter 6. Once everything is in place and the chosen chemicals can be mixed, then the lights can be turned off in the garage or processing facility. The investigator should wait several minutes before beginning any application of the chemicals to the car. One should wait for their eyes to become accustomed to the low-light conditions so that they can see any results. The reactions can be very slight, especially with blood that has been cleaned up. If the reaction is a weak one and the investigator has not allowed their eyes to become accustomed to the lighting conditions, it is possible they may not notice the chemical reaction. While waiting for one's eyes to become adjusted to the low-light condition is a perfect time to complete the mixing of the chosen chemicals. Making sure that all the powders or tabs are thoroughly dissolved is important prior to applying luminol or Bluestar to any surface.

The area where the examination for traces of blood is being performed should be as dark as possible. The environment does not have to be so dark that one cannot even see one's own hand, but should be dark enough that the slightest glow from the chemical's reaction with blood can be observed. If an investigator's facility has windows, they can be easily covered temporarily with black plastic trash bags, boxes, or black butcher paper. Once one's eyes are accustomed to the lighting conditions, the evidence technician can start spraying the area with luminol or Bluestar. There are a couple of choices one has in spraying the chemical onto a vehicle's surface. One is to use a spray atomizer similar to the one used for the moistening of DNA swabs. The second option is to use a plastic spray bottle. The atomizer has an advantage over the pump spray bottle, because it can apply a finer mist across a surface and any bloodstain patterns that develop may be more easily identified. If the pump spray bottle has been selected, then ensure the nozzle is turned to the mist setting and does not come out as a stream of liquid.

Luminol and Bluestar do not destroy DNA, but it will dilute the blood present on a surface. The dilution could cause difficulty for the laboratory personnel in extracting a full genetic profile from any recovered samples. This is another reason for applying the chemiluminescent chemicals in as fine of a mist as possible. Spray the luminol or Bluestar over the surface to be searched and when the reaction becomes visible, it is important to document how the reaction developed and notate the specific hue or color of the reaction. Be sure to cover the entire surface being examined with a thin coat of chemicals. One does not have to saturate the surface. After the chemicals have been applied to the surface, the investigator should make note of any patterns that develop and what and where the patterns were found. The investigator might even use a Sharpie or other permanent marker to mark an outline of the patterns as they develop. Do not forget to photograph the reaction as well. The reaction will not last long, so the evidence technician must be attentive to what is occurring and work quickly with making notations and photographing the vehicle. The investigator has another important item to look for and that is where any blood flow patterns, if present, are moving toward. The investigator is looking for where blood may have settled into a crevice, flowed into, or behind something not on top of an exposed surface. Criminals will clean surface areas but are unlikely to remove trim pieces or pull up carpeting to look behind or underneath these items to clean away all traces of blood. These hidden recesses will possess the best source of blood for DNA testing and is one of the keys to finding a quality blood source for DNA testing.

Photographing the luminol or Bluestar reactions is just as important as trying to find a quality DNA sample left behind in the vehicle. Photographing these reactions is a challenge, but a challenge that can be overcome (Figure 7.14). The photography of luminol and Bluestar and

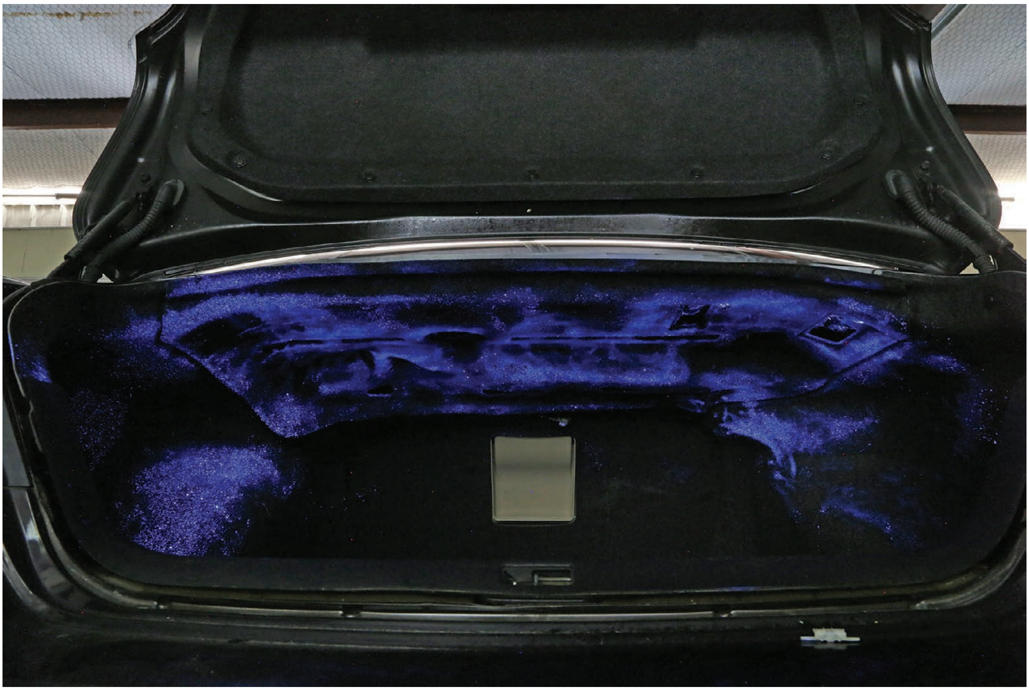


Figure 7.14 The key to recording a quality luminol reaction photograph is to add light into the composition during a timed exposure that allows the reaction to build upon itself on film or digital media. This luminol reaction was recorded at ISO 1600, f/11, for 30 seconds. The reaction was recorded in complete darkness, except for a couple of small background lights that provided a little context to the reaction's location in the vehicle's trunk.

other chemiluminescent reactions are covered in more detail in Chapter 6. As a review, luminol reactions are viewed in near-complete darkness and the key to recording a valuable piece of photographic evidence is to supplement the light in the composition. The challenge is to add just enough light to place the recorded reactions into the context of the scene or the vehicle. Finding a balance in the ISO value (sensitivity to light), aperture (size of the lens opening), and the shutter speed (length of time the camera is recording the composition) is much more flexible because of the low-light conditions and longer exposure times. Light, especially sunlight, actually limits a photographer and what they can do photographically. Consequently, crime scene investigators who are still learning how to use their cameras with confidence should be put at ease because the low-light conditions provide photographers latitude in their exposure calculations.

Remember that the purpose of luminol and Bluestar is to detect hidden bloodstains. The photography of such evidence is important, but the investigator also needs to collect a sample of blood for DNA testing. Without a viable genetic result from testing, the value of the chemiluminescent photographs will not amount to much. Therefore, the investigator does need to follow the blood and hopefully via gravity, the blood flowed to an area not thoroughly cleaned by the perpetrator. This may entail peeling up trim, body parts, carpeting, etc., from the vehicle. The damage to the car is minimal when compared to the value blood can offer to the investigation. Remember that the first application of chemical is an even and light coat of luminol or Bluestar. One does not want to dilute potential trace amounts of blood that might remain in the car. However, once the samples have been taken, a heavier application of luminol or Bluestar can be applied and photographed. The idea for the second round of photographs is that the heavier concentration of chemiluminescent chemicals might produce a stronger reaction and a better subsequent photograph for investigators and court. Once all stain samples are collected and all photographs have been recorded, the evidence technician can return to their other processing efforts.

Semen and Other Body Fluids

Investigators will be asked on occasion to examine vehicles for body fluids other than blood. Typically, the cases involve sexual assaults and requests are made for the search for semen. The search for semen and other body fluids, like any other trace evidence, is conducted by methods that are least destructive to more destructive. As a general rule, the first search for body fluids is with one's own eyes and then with alternate light sources (ALSs). After a visual inspection, examiners can utilize presumptive testing and finally, the examiner can remove the stain or the entire surface from a vehicle for closer examination in the controlled environment of a laboratory.

Other than blood, semen is the most commonly requested body fluid searched for. The visual examination of a vehicle can be done using a standard flashlight or an ALS and looking for areas of discoloration or an accumulation of an unknown substance. When a possible semen stain is discovered, some agencies prefer investigators use a presumptive test kit on the suspected stain (Figure 7.15). The test consists of a small piece of filter paper moistened with the acid phosphatase chemical. A small sample of the unknown stain is collected on a sterile cotton-tipped swab and rubbed on the moistened filter paper. The acid phosphatase filter paper will turn a dark purple in the presence of semen. These test kits can be used to eliminate stains as not being semen, but a common question may develop and that is "What was the stain?" For that reason, many laboratories will request

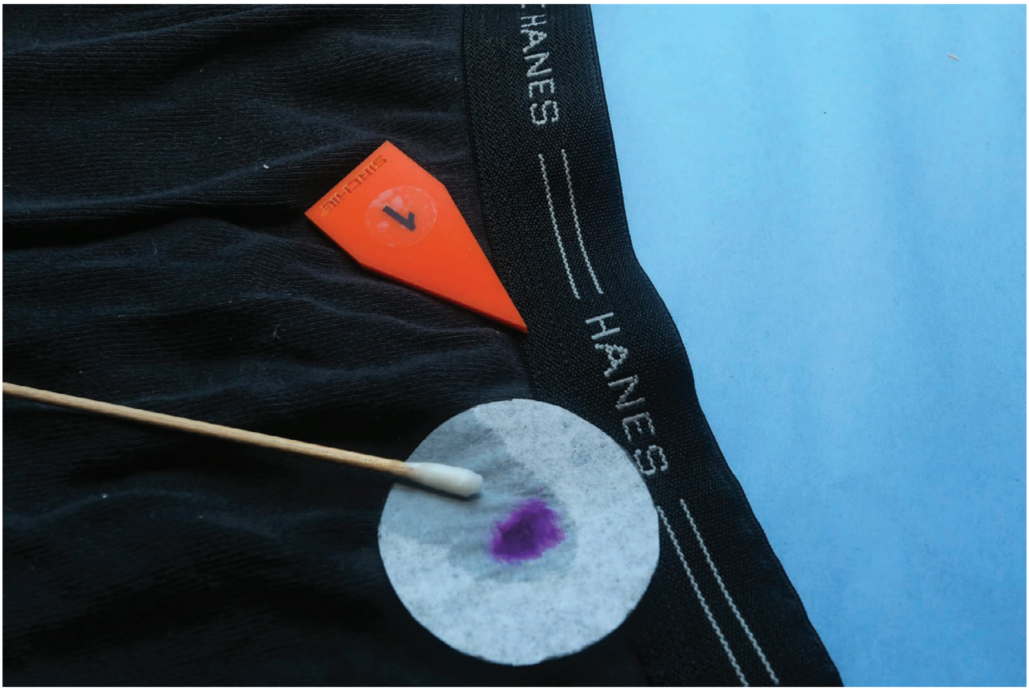


Figure 7.15 Presumptive test kits for semen are commonly sold through crime scene supply companies. These acid phosphatase tests turn a deep purple color when the stain tests positive for the presence of semen.

or have protocols that request that any unknown substance be recovered as evidence and the laboratory can determine what the substance is, not just that it is or is not semen. Investigators should follow their agency's procedures, but as a guiding rule of thumb, it is always better to recover an unknown stain or substance rather than leave it behind.

Visible stains can be collected by one of the five methods previously discussed. Cutting the stain and the substrate it is resting upon, especially if it is leather or fabric, is the recommended method. Evidence technicians can search a vehicle with an alternate light source to assist them with locating any possible latent or hidden body fluid stains. A long dissertation could be included here on how ultraviolet lights travel, how it interacts with different substances and surfaces, and how they can be used to the crime scene investigator's benefit. However, what is most important to crime scene investigators and photographers are the techniques necessary to record evidentiary photographs of subjects not easily seen by the naked eye. Documenting the location of unknown stains and substances with notes and photography is important. Searching for hidden body fluids is made easier with ALS systems, which can be quite expensive. These ALS systems are an investment by any agency, but because they can provide a variety of wavelengths and intensities of ultraviolet light, they provide a great deal of flexibility for the crime scene investigator. Many crime scene investigators do not always have access to such costly ALS systems. The good news is that there are effective, less-expensive alternatives, which will be discussed shortly. Whether an investigator is using an ALS or another style of ultraviolet light, an unseen stain can be made visible and if the stain can be made visible, then it can be found, photographed, and recovered (Figure 7.16).

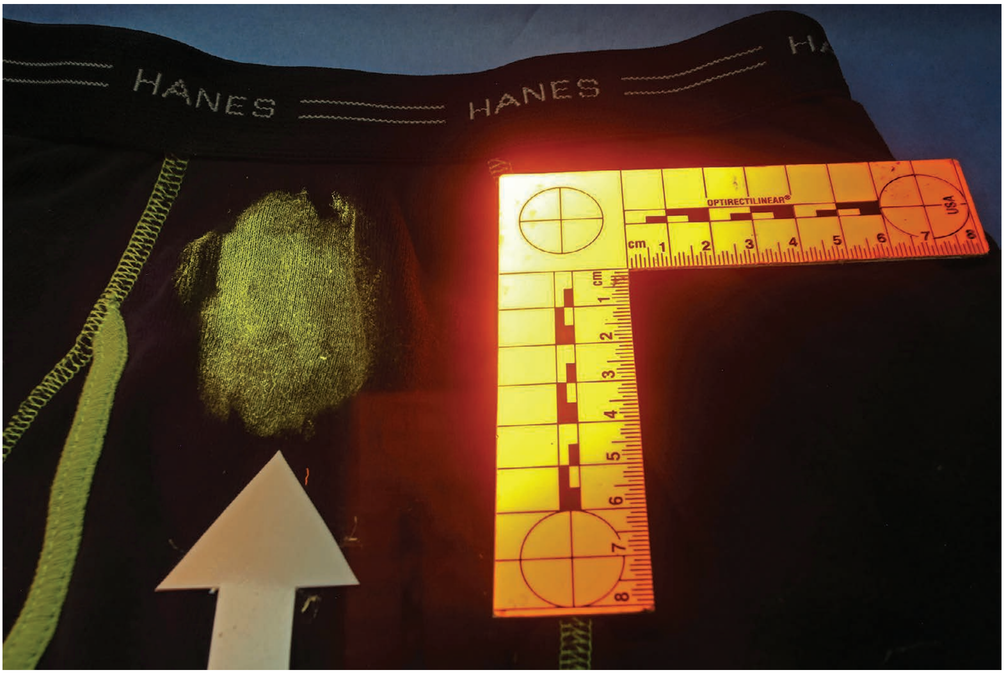


Figure 7.16 Alternate light source units can be a costly investment, but because these units can provide a variety of wavelengths and intensities of light. They are extremely beneficial to the crime scene investigator because they can help locate a variety of substances, such as the semen stain found on the pair of shorts depicted in this image.

Other ultraviolet light sources include black lights, long wave fluorescent tube lights, or light-emitting diode (LED) lights that pass radiation and light just above and below the 400 nm mark, making some of the light produced slightly distinguishable to the human eye. Black lights are commonly found at department stores, especially around Halloween, and are cheaper than those bought from crime scene supply vendors. These lights work in varying degrees of success and require low-light environments in which to operate.

ALS units can cost thousands of dollars and are outside the disposable income of most individual photographers and investigators. However, their intensity and wavelength versatility make their value in crime scene investigations priceless. The more advanced ALS units have the ability to adjust the color of light by fine-tuning the wavelengths. ALS units also have greater intensity than the smaller handheld forensic light sources or battery-powered black lights. The combination of intensity and the ability to fine-tune colored light (wavelengths) make an ALS unit the instrument of choice when it comes to searching and photographing a vehicle with alternate light.

One example of a low-cost alternative to an ALS are LED flashlights. These flashlights have specific wavelength diodes, are relatively inexpensive, and come in a variety of color wavelengths, including:

- Ultraviolet (<405 nm)
- Blue (470 nm)
- Green (532 nm)
- Red (670 nm)

Individual crime scene investigators and photographers are urged to conduct their own experiments in order to determine what works for them and what satisfies their particular needs.

Much misunderstanding surrounds the use of ultraviolet light in the examination of crime scenes and photography. One of the more common errors occurs because television crime shows tend to get it wrong and that is the fact that blood does not fluoresce by itself. It can fluoresce with the use of chemical enhancements, but blood does not magically glow when struck with ultraviolet light. In fact, it does the exact opposite. Blood absorbs ultraviolet light and appears darker to the human eye and to the camera. There are a number of variables present when searching for and photographing body fluids. These variables may affect one's ability to obtain a result with ultraviolet radiation, including but not limited to the following:

- Specific characteristics and intensity of the individual light source.
- The type of surface upon which the reacting substance rests.
- The age and condition of subject matter.
- The type of camera, the quality of lens, and the amount of protective UV coating on the lens's glass elements.
- The selection and use of any barrier filters.

The number of ultraviolet light sources available is seemingly infinite and each light source has its own specific range of wavelengths in which it transmits energy and light. It is even possible that two lights from two different manufacturers that claim to produce the same wavelength actually produce two completely different wavelengths. Furthermore, these wavelengths may change over time as a result of the light source's aging. In addition, the intensity that different light sources can produce will have a direct bearing on the final photographic result. The age of a particular stain may also affect the quality of the photograph captured. As a stain begins to fade or wear away, less material will be available to enhance through the use of ultraviolet light. A camera's lens is also a determining factor in the quality of the photograph ultimately captured. This is even more the case in ultraviolet photography because many lenses have coatings on their elements designed to block ultraviolet light. In some cases, this might be advantageous because while the excitation effect of the ultraviolet energy is blocked, the visible reaction can still be recorded. Finally, the use of barrier filters, typically in the colors of yellow, orange, and red, can generate better contrast and improve the overall visibility and contrast. Just mentioning these few considerations are meant to illustrate the value of experimentation with one's own equipment in order to gain an idea as to when and how ultraviolet light might be advantageous.

Examining vehicles with ultraviolet light is completed in darkened conditions, much like the search for hidden blood using luminol or Bluestar. Because of the need for low-light conditions, searches for body fluids using ultraviolet light should be completed in the secure environment of a vehicle examination facility or garage. When the ambient light has been eliminated, the investigator can run the ultraviolet light over the surfaces in question. If the investigator has the ability to utilize different wavelengths, the search should continue until a result is developed or until all the wavelength choices have been exhausted. The investigator should also remember to utilize the barrier filter to help make possible evidence more visible. Barrier filters typically come in red, orange, and yellow. Commercially available units are packed with matching eye protection goggles of the same colors. In general, the yellow filters are used with the shorter wavelengths of light, 350–470 nm (violet to blue); the orange filters are used in the mid-range of visible light, 470–555 nm (blue to green), and the red filters are used with the longer wavelengths of light above 600 nm (orange to red). These wavelengths are approximations and can vary depending on the color of the fluorescing material and the substratum the material rests upon. Therefore, do not be surprised if a red filter creates the best contrast when utilizing a blue (470 nm) wavelength of light. At the very least, these cited wavelengths give investigators a starting point from which to begin their search for the optimal combination of wavelength and barrier filter that are likely to produce the best result. If the investigator is successful at finding a reaction in the vehicle, then the reaction must be photographed prior to recovering the stain sample or fluorescing substance. Ultraviolet light photography is discussed in much greater detail in Chapter 6.

Conclusion

The processing of vehicles for biological material is a common request in violent crimes that involve bloodshed and/or sexual assault cases. As with all evidence, it must be well documented and photographed so that all stains, whether known or unknown, are understood within the context in which they were found. Finding trace amounts of biological evidence can be a challenge, especially if there has been any attempt at cleaning the vehicle by the suspect. Recognizing the need and how to use the photoluminescent chemicals luminol and Bluestar to find hidden traces of blood and the use of ultraviolet light to find hidden traces of semen, saliva, and other biological fluids is of immense value. In fact, evidence technicians should practice with these tools prior to partaking in the processing of a vehicle used in an actual criminal offense. Once the stains and substances have been located and documented, they need to be collected. Standard techniques were discussed, including swabbing, cutting, scraping, tape lifting, and simply collecting the entire object. The ultimate decision of which technique is chosen is up to the investigator and based on what type of surface the biological material was found and how they believe is the best way to collect an uncontaminated sample that can have a full genetic DNA profile extracted. Once collected, the evidence must be packaged in a way that preserves not only the evidence but also the integrity of the evidence. If the chain of custody is not maintained, then the evidence will have no value in a court of law.

Additional Readings

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Review Questions: Deoxyribonucleic Acid Evidence

1. Who helped identify Colin Pitchfork in the first use of DNA evidence used to identify a murderer?
   a. Gregor Mendel
   b. Francis Crick
   c. James Watson
   d. Alec Jeffreys
2. Who developed the DNA amplification method of polymerase chain reaction?
   a. Gregor Mendel
   b. Francis Crick
   c. James Watson
   d. Kary Mullis
3. Who was the Augustinian Monk who conducted early hereditary studies in the 19th century?
   a. Gregor Mendel
   b. Francis Crick
   c. James Watson
   d. Alec Jeffreys
4. Which is NOT one of the four base nucleic acids that combine to create the DNA molecule?
   a. Adenine
   b. Cytosine
   c. Germine
   d. Thymine
5. How many “Core Loci” do the CODIS databases recognize?
   a. 13
   b. 20
   c. 23
   d. 32
6. Which is the most common method of recovering “Touch DNA” evidence?
   a. Swabbing
   b. Scraping
   c. Cutting
   d. Tape Lifting
7. Which is the best description of how one applies distilled water to DNA collection swabs?
   a. Saturate
   b. Moisten
   c. Drench
   d. Soak

8. Which tool would be best for scraping human tissue material off a car's fender?
   a. Clean screwdriver or chisel
   b. Pocket knife wiped down with alcohol
   c. Sterile scalpel blade
   d. Any of the above
9. What is a good practice when cutting a stain out of a car seat?
   a. Trim as small of a piece of the seat as possible to protect the owner's property
   b. Remove the seat from the vehicle and submit as a whole
   c. Only cut out a biological sample when a tape lift is not feasible
   d. Always cut well around the stain to ensure the entire stain is collected
10. What is another name for a DNA sample collected from someone's mouth?
    a. Mitochondrial swab
    b. Buccal swab
    c. PCR swab
    d. Molar swab
11. What should an investigator do prior to the application of luminol onto a vehicle's surface?
    a. Prepare all photographic and evidence collection equipment prior to start
    b. Turn off the lights and allow the investigator's eyes to get accustomed to the dark
    c. Prepare the luminol solution
    d. All of the above
12. What color does an acid phosphatase test turn in the presence of semen?
    a. Blue
    b. Green
    c. Purple
    d. Red
13. What color does luminol fluoresce in the presence of blood?
    a. Blue
    b. Green
    c. Purple
    d. Red
14. How much ambient light should be used when processing a vehicle with Bluestar?
    a. As little light as possible
    b. One or two bright lamps next to the vehicle
    c. Overhead lighting from the vehicle examination building should be shining
    d. Process the vehicle outdoors during the daytime
15. Which type of tape is Not appropriate when collecting "tape lifts" from a motor vehicle.
    a. Fingerprint tape
    b. Duct tape
    c. Packing tape
    d. All of the above tapes are acceptable

Fingerprint and Impression Evidence Involving Motor Vehicles

8

There are two duties an investigator is commonly tasked with when processing a vehicle. Those are the recovery of latent fingerprints and deoxyribonucleic acid (DNA) evidence. Processing a vehicle for latent prints is similar to processing any other crime scene. It begins with choosing the right tool for the job. There are numerous die stains and chemical processes that evidence technicians may use on specific evidence found inside of vehicles, but this chapter addresses the processing of the vehicle itself. Processing individual items found inside the car can be completed in a laboratory, where investigators have access to a variety of powders, die stains, and chemicals. Most vehicles are typically completed using standard powder processing techniques. Evidence technicians will likely have their favorite combination of powders and brushes that they use when processing evidence. However, there will be a few unique surfaces found inside the car that might benefit from some unique processing techniques. Even though utilizing tried and true techniques in developing latent fingerprints are recommended most of the time, there will be other times in which “thinking outside of the box” can be beneficial.

Powder Processing Tools

The basic and most common fingerprint powder is black powder. Powders come in a variety of colors so that the person processing the evidence can observe the contrast between the color of the surface and the color of the powder (Figure 8.1). As advantageous as using different colored powders may be during processing, when the latent print is lifted and applied to a white, black, or gray fingerprint-lift card, the latent print examiner must compare it to a known exemplar. Exemplars are generally a black print on a white background. Therefore, if a white print is placed on a black card, then the identification of that print will be problematic at best because of the reversed tones. Granted, the print can be photographed and the color inverted, but that just adds another unnecessary step to the process. There is a solution and that is simply using a flashlight or other light source at an oblique angle across the surface being printed and one can easily see black powder on a vehicle’s black painted surface (Figure 8.2). Of course, investigators have a myriad of choices on fingerprint powders and colors, but the “KISS” (Keep It Simple Stupid) method is generally a good philosophy to follow, especially in large volume environments, such as vehicle processing facilities. Obviously, investigators can keep a small selection of different colored powders for special occasions. The actual processing techniques of different colored powders are quite similar. There is a recently released product available that has the potential to eliminate the need for different colored powders. The fingerprint powder is known as “Electric Fingerprint Powder” and it is sold by the Lynn Peavey Company®. The powder can be found in a variety of colors, but the basic black would be most advantageous to the fingerprint examiners that must compare the lifted prints with the known exemplars. When a flashlight is cast on a latent print enhanced with “Electric Powder,” the fingerprint reflects the light and causes it to stand out against the dark background (Figure 8.3). However, when the print is lifted, the latent print processed with black powder is more easily evaluated and compared by a fingerprint examiner.

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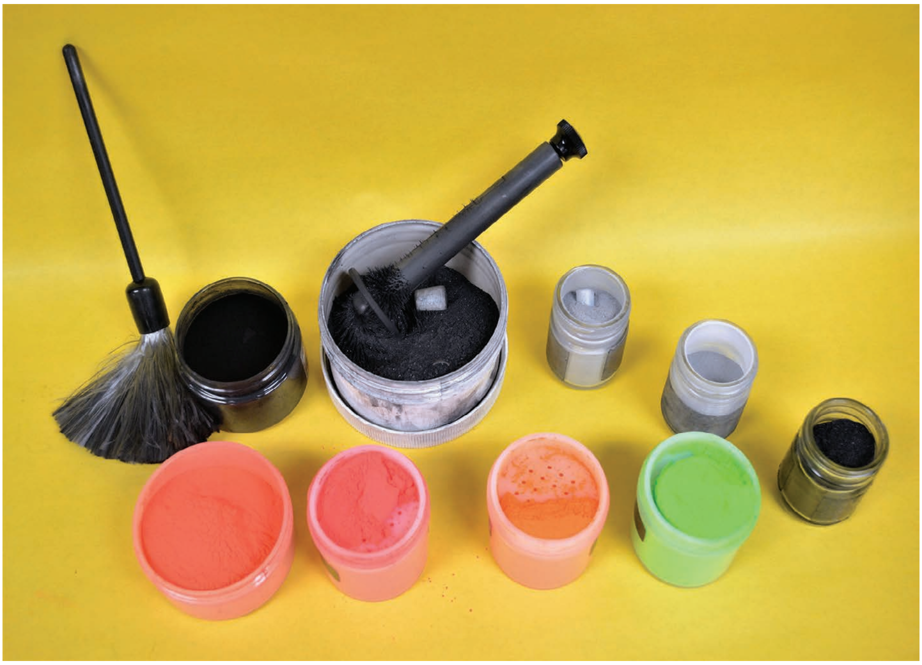


Figure 8.1 Fingerprint powders come in a variety of colors and textures. Generally, black volcanic or graphite powders are the most common and widely used. However, investigators should still have a couple of choices for special situations and unexpected or difficult surfaces. This photograph shows graphite, magnetic, and fluorescent powders in a variety of contrasting colors.

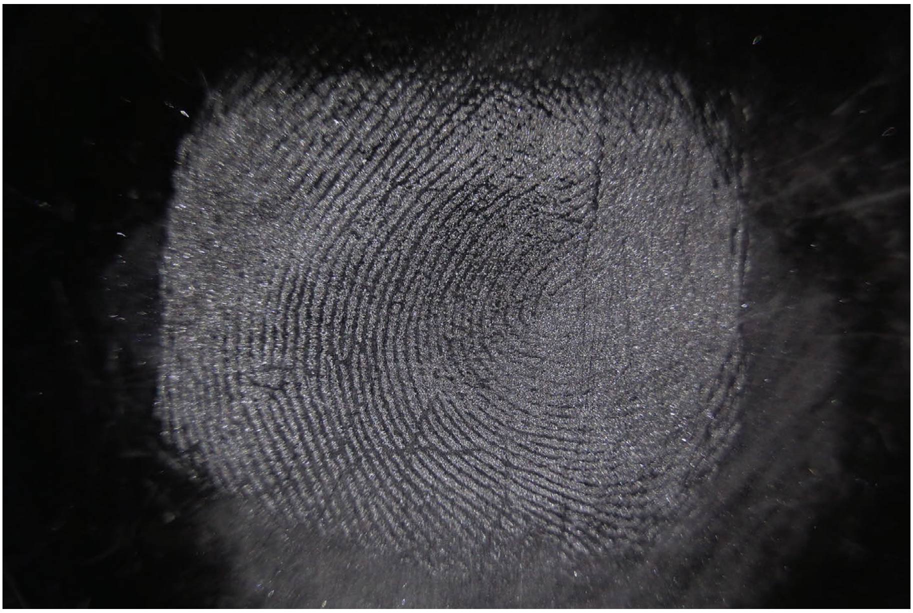


Figure 8.2 By casting light obliquely across a dark surface, investigators can still visualize the presence of fingerprints enhanced with black powder. The need to have a contrasting powder is not always necessary, but helps eliminate the extra steps of photographing the fingerprint and inverting the color.

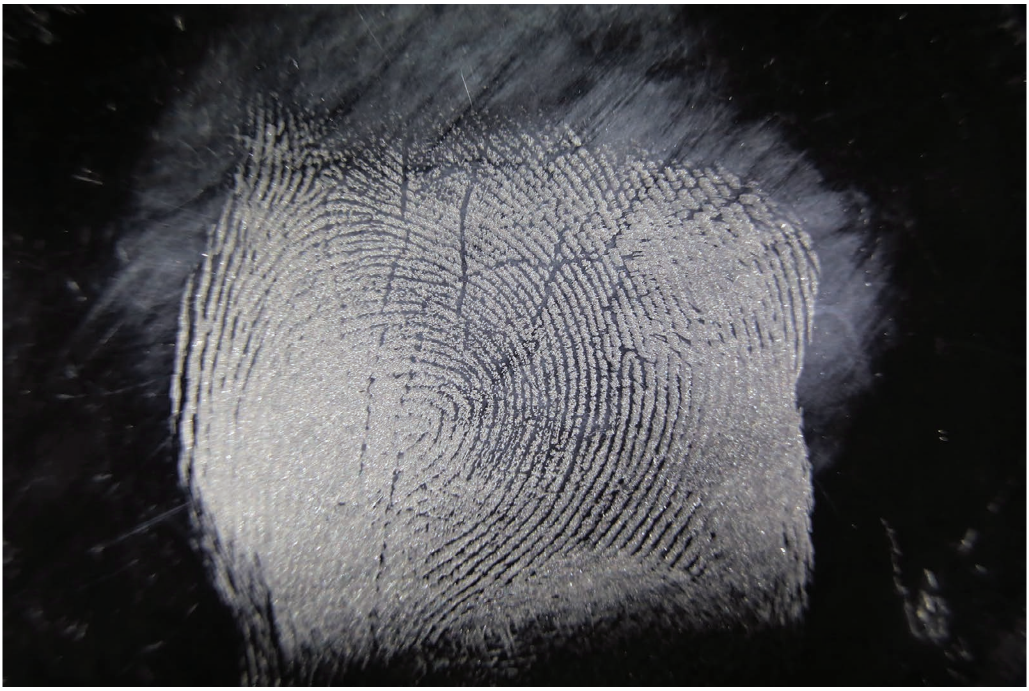


Figure 8.3 White or silver fingerprint powder can be used easily on dark surfaces and the latent print will stand out on the contrasting surface. However, the print must be photographed and the color inverted before a comparison can be made. The Lynn Peavey Company developed this black "Electric Fingerprint Powder" that shines when light is applied, but will lift like any other black fingerprint powder.

Among the different powders, there are two major categories: black graphite or volcanic powders and magnetic powders. Magnetic powders have numerous advantages, including being a much cleaner medium to work with and a smaller chance of damaging or obliterating a latent fingerprint. As will be discussed later, magnetic wands have the advantage of applying powder onto a print without having to actually touch the latent print with the wand. A fingerprint dusting brush will come in contact with the latent print and can damage a print inadvertently. Unfortunately, it is difficult to use magnetic powder on vehicles because there are so many metal surfaces. However, that does not prevent an investigator from using magnetic powder on the interior of the vehicle and on individual items found inside the vehicle.

Investigators must next choose a fingerprint (powder) brush that they prefer to use. There are different types of fingerprint brushes and investigators typically have their own favorite style of brush. Some of the standard fingerprint brushes include feather brushes, fiber or fiberglass brushes, and camel or horsehair brushes (Figure 8.4). The specific brush chosen will depend on the individual investigator and their particular brushstroke technique. For example, feather brushes can be a better choice when one's brushstroke is more of a side-to-side technique. On the other side, those investigators who prefer to spin or twirl their brushes will benefit from the fiber or fiberglass style brushes. Results using horsehair brushes are also improved by circular type of strokes. In addition, many investigators like to use horsehair brushes as a print "cleaning"-type brush. These brushes are used to clear excess powder from prints developed with fiberglass or feather applicators.

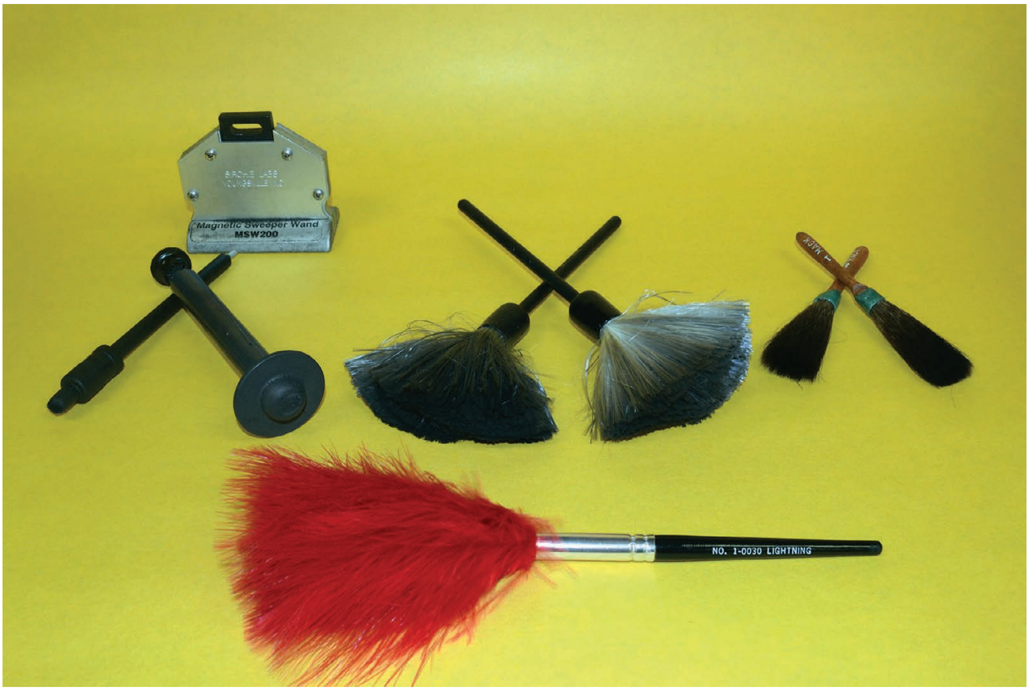


Figure 8.4 Fingerprint brushes and applicators come in a variety of styles. Pictured here from left to right are examples of magnetic wands, fiberglass, and horsehair brushes. A redfeather-dusting brush is sitting in the foreground.

Another aspect of fingerprint brushes involves the choice between using a new, clean fingerprint brush or an older, powder-laden fingerprint brush. A fingerprint processor will develop a preference for one or the other. Unused fingerprint brushes have nicely shaped bristles, with a nice even edge to them which may make the application of the powder smooth and even. On the other hand, all the clean bristles may not get a nice even coating of powder on them causing streaks to appear in the print's development. Although those areas where powder was not applied to the surface are easily removed with a second or third pass with the fingerprint brush. This is one reason why some investigators prefer to use a brush that has been "broken in." The application of powder can be more uniform with a used brush. The drawback with used brushes is that brush fibers can become clumped and uneven at the ends. Fingerprint processors have been known to become attached to their favorite brushes and one way to keep them lasting a bit longer is to keep a small plastic comb and a pair of scissors in the fingerprint kit. The comb can be used to separate the clumped together bristles and the scissors are used to even up the ends of the bristles. There might be one forensic drawback to using a used fingerprint brush and that is the consideration, no matter how small, about the potential transfer of DNA from one vehicle to another. Although the chances of transferring a full genetic profile from one vehicle to another are unlikely, one could introduce contamination issues into the investigation. Crime scene supply companies do sell "Single-Use" fingerprint brushes and powder packages, but the decision on their use will likely come from the crime scene unit and laboratory administrators that place such requirements in standard operating procedures (SOPs). If you do not have any specified SOPs and an investigator is concerned over DNA contamination, simply collect all the desired DNA samples first and process for latent prints second.

Fingerprint processors must also make a choice between the different lifting tapes and hinge-style lifters available. Fingerprint tapes come in a number of different styles, including:

- Frosted lifting tape
- Clear lifting tape
- Polyethylene lifting tape
- Hinge lifters
- Specialty tapes
    - "Rough Texture" lifting tape (Evident® www.shopevident.com)
    - "Stretchable" lifting tape (Evident @ www.shopevident.com)
    - "Rubber Jell" or "Gel" lifting tape (Sirchie® @ www.sirchie.com)
    - "Gel" lifters (Sirchie @ www.sirchie.com)
    - "Diff-Lift" tape (Lynn Peavey Company @ www.lynnpeavey.com)

Each style of tape has its own particular advantage for different types of surfaces. Frosted and clear lifting tapes are excellent choices for car exteriors and glass, while the Gel or Rough Texture lifting tapes would be advantageous on textured surfaces found inside of the vehicle. Tapes also come in a variety of widths, from 1" wide to 4" wide. The 4"-wide tape is typically used for latent palm prints or clusters of fingerprints found on a surface. The narrower tapes are commonly used for individual prints found on surfaces. However, processors can lift larger latent prints by overlapping multiple strands of narrower pieces of tape together. Fingerprint processors should have an assortment of different tape widths to accommodate the different sizes of latent prints that can be found (Figure 8.5). Another consideration is also the size of the individual's hand. If

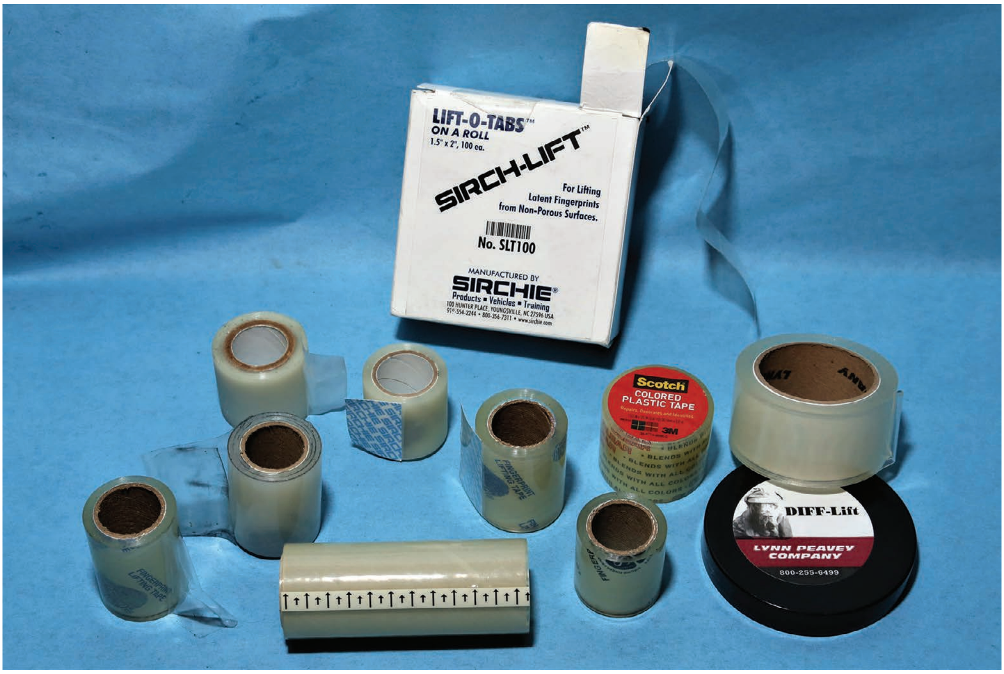

LIFT-O-TABS™
ON A ROLL
1.5" x 2", 100 ea.
SIRCH-LIFT™
For Lifting Latent Fingerprints from Non-Porous Surfaces.
No. SLT100
MANUFACTURED BY
SIRCHIE®
Products • Vehicles • Training
Scotch
COLORED PLASTIC TAPE
3M
DIFF-Lift
LYNN PEAVEY COMPANY
800-255-6499

Figure 8.5 Fingerprint tapes and hinged lifters come in a variety of widths and styles. Over time, investigators will find a width of tape that they can manipulate the best and whether they prefer clear, frosted, or some other type of fingerprint tape or hinge lifter.

the evidence technician is a smaller person, the 2"-wide rolls of tape may be difficult to control. Hinge lifters also come in different styles and sizes and if the hinge-style lifters are a processer's preference, possessing a variety of different sized lifters is important, because the hinge lifters cannot be overlapped and made to cover larger prints like fingerprint roll tape is able to.

As with any endeavor, practice, practice, and more practice is the key to becoming proficient at finding, processing or developing, and lifting latent fingerprints from a variety of surfaces. Finding the latent fingerprints on surfaces is not a difficult task. Oblique lighting, similar to what is demonstrated in Figure 8.2, is one of the investigator's best tools. Crime scene investigators should always have a flashlight at their disposal, even if one is assigned to the dayshift. Alternatively, evidence technicians can simply powder a vehicle's surface, i.e., process the vehicle's surface with fingerprint powder, and search for latent prints "blindly." It is not as bad as it sounds. When processing vehicles, especially the outside of vehicles, it is better to process the surfaces with powder whether one can see a latent print or not, because this will help ensure a potential print is not missed. The word "latent" does mean "hidden" and investigators are tasked with finding these unseen prints. Therefore, processing the entire exterior surface of a vehicle is actually not that daunting. It may be time consuming, but crime scene investigation is not about speed, it is about thoroughness. Good evidence technicians are thoughtful, meticulous, and thorough. In that way, investigators can get on the stand in a criminal court and testify that they did everything possible to find all the evidence present.

Processing the Vehicle's Exterior for Latent Fingerprints

The first task for an evidence technician or fingerprint processor to complete is to speak with the case investigator and get a clear picture of the crime and the type of evidence needing recovery. When fingerprint evidence is requested, the technician should gather all their equipment, including:

- Gloves (cotton gloves and latex gloves)
- Fingerprint powder
- Assorted brushes
- Assorted tapes
- Fingerprint lift cards
- Scissors and/or sharp pocketknife
- Flashlight
- Rolling cart to put all the supplies on
- Clipboard for recording notes about findings and observations (and writing pens)

An investigator's job will be made much easier with the proper equipment. One such helpful piece of equipment is a rolling cart. The cart can hold all the investigator's supplies and move around the car as the processing of the vehicle proceeds. Granted, this is not always possible in the field, but when working in a controlled environment like a vehicle examination facility, investigators will be much more efficient when they are properly equipped. It is recommended to cover the cart's top surface with butcher paper. Processing for latent prints is an extremely dirty process and the paper helps keep the work environment just a little bit cleaner. The technician can lay out their supplies on the cart in the most convenient way for them. Remember, to have different types of fingerprint brushes, powders, and tapes available, because cars will have a variety of surfaces on them from glass, rubber, plastic, metal, to fiberglass. Furthermore, the paint on cars will age over time and oxidize. This can create a need for a specialty fingerprint tape, like "Diff-Lift" or "Gel Lift" tapes. Always have a pair of scissors available as well. Scissors will be helpful throughout the processing of the vehicle but will be needed to cut some of these thicker gel tapes that are not as conducive to tearing by hand.

Evidence technicians will go through numerous gloves while processing vehicles. Therefore, having a box of gloves and not just a "few" pairs is a must. Gloves should fit snuggly, but still allow one to make a fist without feeling pinched. Wearing too big of a glove, with the fingertips having little floppy ends, will be extremely aggravating when spinning a fingerprint brush or trying to peel fingerprint tape off a car's surface. Another beneficial tip is to wear two pairs of gloves when processing fingerprint evidence. The pair of gloves put directly on the hand can be cotton gloves and the outer pair can be the standard nitrile or latex gloves (Figure 8.6). If anyone has ever tried to put on a pair of latex gloves on a pair of sweaty hands, then they know the value of wearing two pairs of gloves. If one does not have cotton gloves, then they can use a second pair of latex gloves and simply double them up. However, the cotton gloves absorb sweat instead of having the sweat drip out of the gloves and possibly fall onto the surface being processed for latent prints. The cotton gloves have an added bonus when laying down fingerprint tape over the developed prints. Fingerprint processors can cut the pointer finger off one pair of the nitrile gloves, thereby exposing a cotton-gloved pointer finger while the remaining fingers are protected by the latex gloves. When laying down the fingerprint tape, it is important to lay it down smoothly without any air bubbles. The cotton glove allows the investigator to smooth out the tape much easier than the tacky latex gloves can.

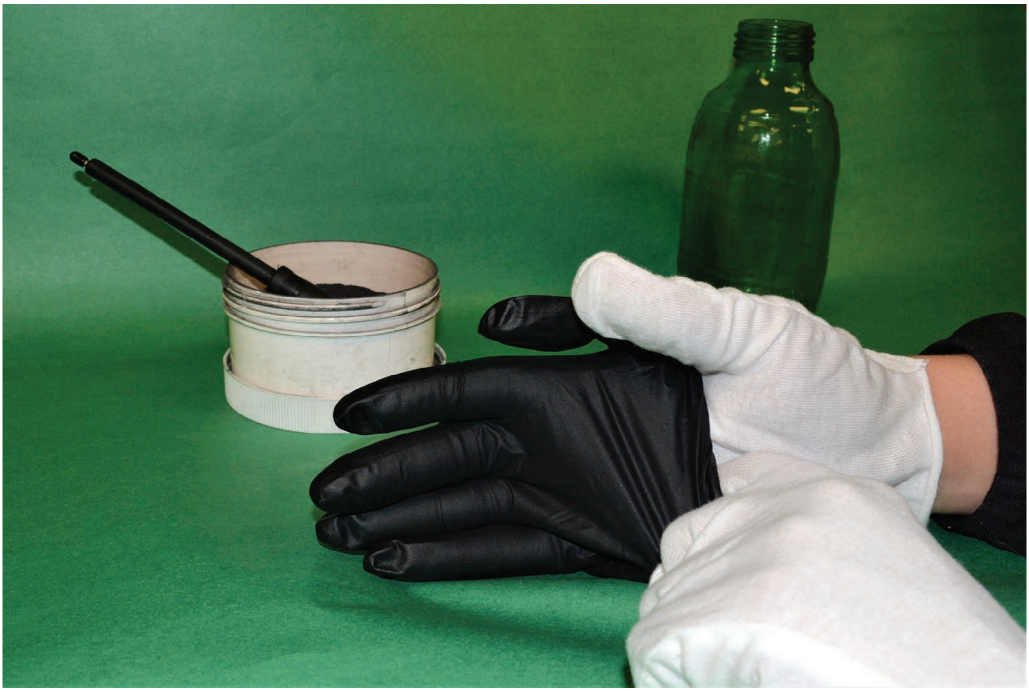


Figure 8.6 Wearing two pairs of gloves, a pair of cotton gloves and a pair of latex gloves, is quite beneficial and helps with having to re-glove a sweaty hand. The cotton gloves are also better at smoothing out fingerprint tape across a surface than latex or nitrile gloves.

Powder Processing of Vehicles

Developing fingerprints involves the application of one's chosen powder onto the surface of the vehicle or object being printed. The two biggest errors in fingerprint processing are using too much powder and too much pressure. In order to prevent accumulating too much powder on a print, some technicians recommend not dipping the fingerprint brush directly into a jar of powder. Instead, sprinkle the powder out of its storage container onto a piece of paper and dip your brush on the smaller volume of powder. That is an excellent suggestion for smaller items or surfaces, but the sheer size of a motor vehicle makes that option a little impractical.

Think of the total square footage of a full-size sports utility vehicle (SUV) and processing that vehicle with a fiberglass brush that might spread out to approximately 3" in diameter. An SUV may have a total surface area of 170-plus square feet and even a mid-size car will have approximately 90 square feet of surface area to print. That amount of processing is going to require quite a bit of fingerprint powder. Consequently, having something more practical to hold one's fingerprint powder in might be advantageous. One recommendation is to use something like a large coffee can. The coffee canister will certainly hold a large quantity of fingerprint powder, but one does not want to fill up the container with powder. Simply put approximately a half inch of powder in the bottom of the can, because the empty and tall sides of the can will be of benefit to the processors. The amount of print powder that is placed in the coffee can or like container is dependent on the number of vehicles that the evidence technician is responsible for processing. If it is just one car every so often, then one does not need as much powder. If one is working in a vehicle examination facility and is processing vehicles all day, every day, then they might want to place a little more powder in their container. On a side note, fingerprint powder is typically packaged with small moisture capturing capsules. Do not throw those capsules away. Keep them with the powder. Nothing will ruin one's supply of fingerprint powder faster than moisture. A tall coffee can or similar container will naturally have tall sides and this has two tremendous values. First, the larger container is easier to grasp and move around the vehicle with while processing it. In addition, even if the can is knocked over on its side, the relatively small amount of powder inside will not spill out. The small little containers that fingerprint powder typically comes in will spill out on the floor rather easily. Second, the tall sides of the can help investigators from having too much powder on their brushes. Remember, "too much powder" is one of the major errors committed when processing latent prints. In order to eliminate that possibility, after the brush is dipped into the powder within the large can, the brush can be vigorously spun inside the can and/or smacking the handle of the brush against the rim of the can to shake off the excess powder. A bonus is that the excess powder is not lost and flying around in the air to be breathed in and turning an investigator's nostrils any more black than they are bound to become. Therefore, using a larger container, with tall sides, helps the examiner keep the work environment clean, as well as helping the investigator process their vehicle more efficiently.

For those times that DNA evidence has not yet been collected or is of concern, it is best to use the fresh powder directly from its original packaging. A small amount of powder can be placed in a disposable Styrofoam-style bowl (Figure 8.7) and disposed of after the vehicle's processing has been completed. The unused powder could also be placed back into the larger coffee can type container for use on other vehicles. Investigators should also use a new fingerprint brush when concerned about contaminating potential DNA evidence. Forensic supply companies generally offer for sale single-use fingerprint brushes for those times when attempting to avoid contaminating DNA.

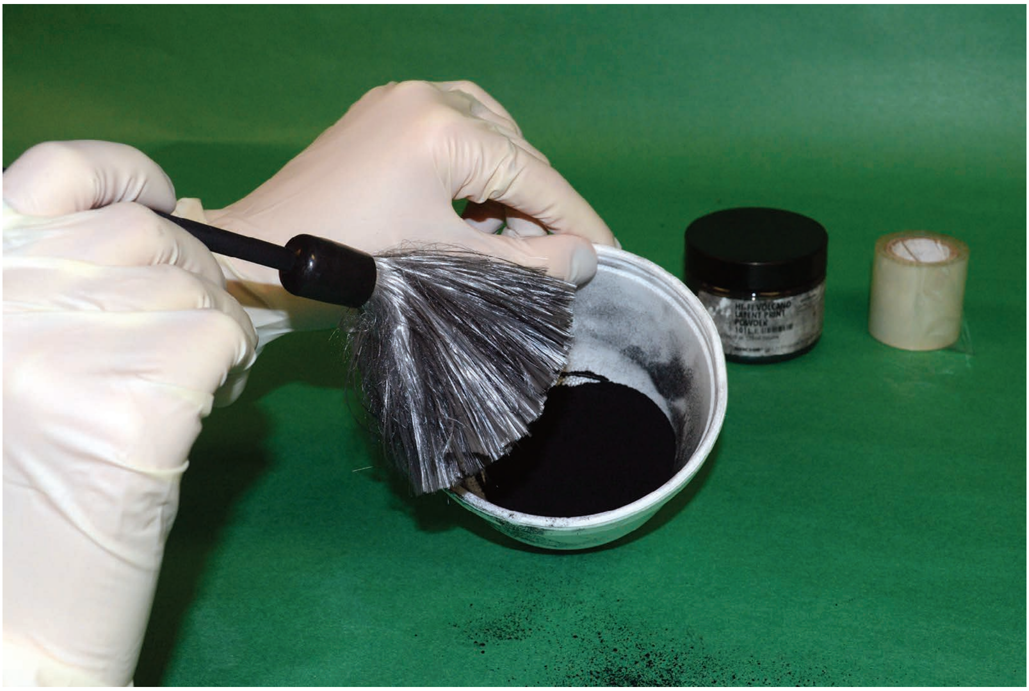


Figure 8.7 Small disposable bowls can be used to hold one's fingerprint powder when processing vehicles for fingerprints and when there is a concern of contaminating potential DNA evidence.

There is another option available to evidence technicians for processing the large surface area of a vehicle's exterior. Some forensic supply companies sell a special glove that can be used to process larger surface areas. The glove looks like a car-washing mitt, but instead of soap and water, the technician applies fingerprint powder to the glove and can cast large swaths of powder across a vehicle's surface. This does search for fingerprints faster, but not necessarily better. There is a greater risk of putting too much pressure on the vehicle's surface, thereby obliterating any prints available. However, if the fingerprint processor is very careful and possesses a light touch, this technique can be efficient in locating prints. A standard fingerprint brush will still need to be used to put the finishing touches onto a developed print. Therefore, the fingerprint-glove technique may have its use on occasion, but the risk of losing latent print evidence for the sake of speed is not an acceptable trade-off.

Investigators should develop a systematic routine on how they go about processing vehicles, such as starting at the front right corner of the vehicle and working counterclockwise around the entire vehicle. Having some sort of "routine" or "standard procedure" will help eliminate accidentally forgetting to process an area of the car. Once in a while, investigators will be given specific information to check a very specific part of the car for latent prints and that explicit area can be processed out of turn, as long as the investigator returns to their set practice of powder processing the vehicle for prints. Another general processing decision that needs to be made is whether the investigator will powder process and tape lift each print as they are developed or powder the entire car and return to tape lift the developed prints. If the investigator is fortunate enough to have an assigned area, like a vehicle examination facility, then the most efficient method would be to process the car with powder and then apply the fingerprint tape over any developed prints when completely done with powdering the entire car. However, if the investigator is in the field, the weather may dictate how the processing of the vehicle proceeds. Crime scene investigators always try to maintain consistency but must remain flexible. Especially with something they are unable to control, like the weather. Investigators are constantly making adjustments to their processing, but in the big picture of processing vehicles, investigators should develop a routine that ensures a methodical and efficient approach to the vehicle's examination.

The fingerprint process begins by placing powder on the fingerprint brush. For now, the discussion involves standard black powder processing. The brush should be tapped lightly into the investigator's chosen container of powder and a couple of short spins of the brush through the powder for good measure. Any excess powder should be shaken, tapped, or spun off so that an even, light coating develops on the ends of the brush's hairs, fibers, or feathers. After dipping and spinning your brush in the fingerprint powder and shaking off the excess powder, the processor needs to spin the fiberglass or hair-type brushes across the surfaces being processed. As a side note, feather brushes can be spun as well, but work equally well being brushed straight across the surface. Spinning the brush is easily done by rotating the brush's handle between the forefinger and thumb. Regardless of the brush-type selection, remember the warning about not applying "too much pressure" when dusting for latent prints. Only the very ends of the bristles or feathers should touch the surface being dusted (Figure 8.8). Unless one can visualize a definite area where a print is present, processors will be moving in broader swaths across the vehicle. When a print starts becoming visible, then the investigator can slow down and concentrate in that area lightly spinning the brush over the latent print in order to enhance it. When enhancing the print, it is best to make smaller circular brushstrokes so that the print is not damaged and is developed to its ultimate potential.

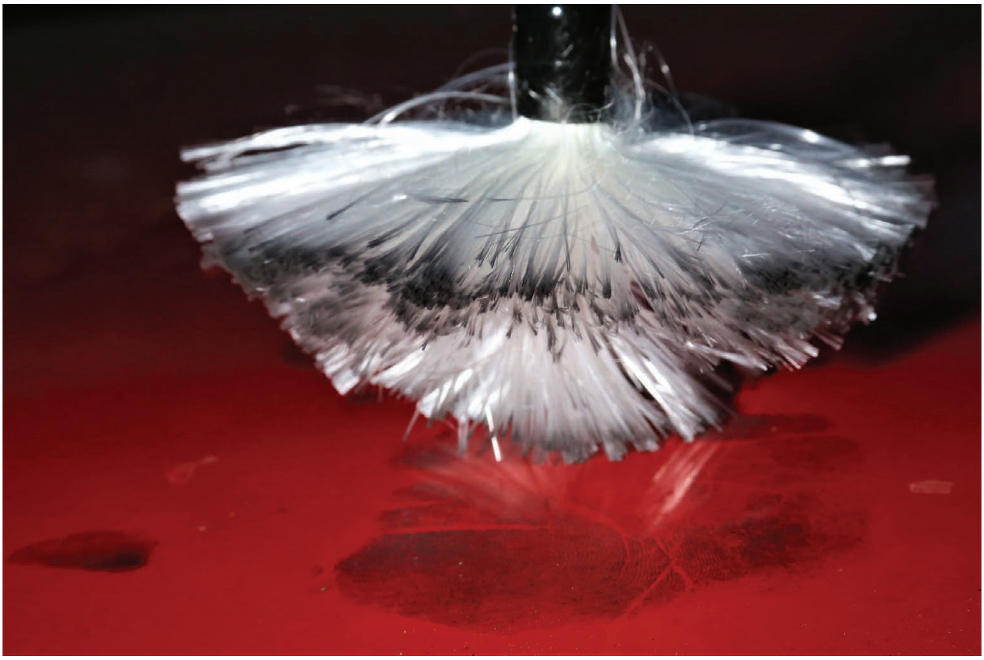


Figure 8.8 Notice how only the tips of the dusting brush come into contact with the surface. Too much pressure on the brush can easily result in an obliterated print. Fingerprint processors must maintain a light touch when powder processing for latent prints.

The processing of the outside of the vehicle is continued around the exterior of the vehicle until the exterior of the vehicle is completely processed. The latent fingerprints developed will likely still need some “fine tuning” or “finished touches.” At the very least, there is bound to be excess powder floating around and laying across the prints already developed. Regarding the processing of the vehicle’s exterior, there is an incorrect philosophy or belief that is argued from time to time. Some people will argue that the exterior of the vehicle does not need to be processed because a district attorney is not going to take charges on a suspect because their fingerprint simply was found on the exterior of a vehicle. Although that may be a partially true statement, the job of an evidence processor is to find all the available evidence and not to judge potential evidence based on whether or not it will lead to charges against a specific person. If the print can lead investigators to a “person of interest” and that leads to a confession or other additional evidence that might only have been found had investigators known who to look at, then and only then has the fingerprint processor done their job.

As each latent fingerprint is developed, the evidence processor will need to “fine tune” or put the “finishing touches” on them prior to lifting. These finishing touches include ensuring the whole print has been developed, removing any excess powder, and making certain that the developed print has enough density for a potential comparison. As the overall processing of the vehicle continues, loose powder will naturally float in the air and land across areas already processed. For that reason, evidence technicians do not have to perfect each and every print as they initially continue around the vehicle. The fine-tuning of a print can be completed just before the technician prepares to lay the tape across the print. When it is time to complete the finishing touches, the examiner should ensure that the print has enough powder to give the examiner a quality, well-contrasting print. If there are any “soft” or “light” areas where additional powder would be advantageous to the fingerprint examiner, then that sort of fine tuning should be completed at this time. Once the print is developed with the powder, the examiner should blow off any excess powder that might have settled on the print. The investigator can use the air in their lungs to complete this process, but it is very important to make sure that one swallows any saliva in their mouth so that no moisture is cast across the print. If the investigator is unable to blow moisture off the latent print without leaving moisture behind, they can use a camera lens cleaner designed to remove dust from a camera’s lens (Figure 8.9). A bulbous blower is also useful when an investigator is concerned about DNA contamination. The lens cleaner typically has a rubber bulb that when depressed will expel air without the threat of moisture getting on the print. Furthermore, these lens cleaners typically have a soft hairbrush at the end, which can be used to lightly brush away any stubborn unwanted fingerprint powder grains.

When processing vehicles for latent fingerprints, investigators should have a variety of fingerprint brushes available to them. Even if one has a favorite type of fingerprint brush, they should have more than one. Fingerprint brushes do not need to be discarded after every vehicle is processed. Investigators are likely to find that used brushes are preferable, because they have a nice even coating of powder already on the bristles. However, when cleaning a developed latent print of excess powder, while at the same time making sure the print is fully developed throughout, the investigator would benefit from having a newer fingerprint brush similar to their brush of choice for overall processing. Of course, this brush will get broken in over time and then be better suited for the overall processing of the vehicle. By that time, it may be time to retire the primary brush and rotate the broken-in brush into its new role as the primary processing brush. Do not throw away the well-used brush just yet. Eventually, an investigator is going to have to process a vehicle is that is, for a lack of a better word, just plain

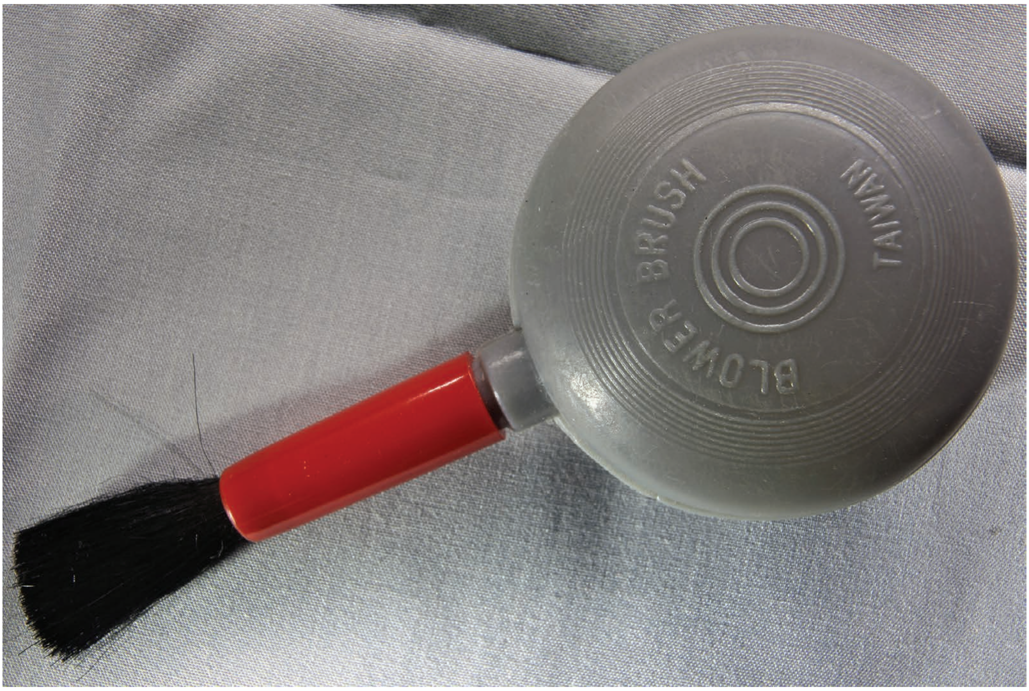


Figure 8.9 A camera lens's cleaning brush can be used by fingerprint processors to remove excess powder from developed prints without the risk of casting moisture onto the prints by blowing air from the investigator's mouth. A bulbous air blower also eliminates the potential of adding one's own DNA to the printed surface.

nasty. Vehicles where a decomposed body may have been in or a large volume of bloodstains are present will make the recovery of fingerprints a challenge at best. Therefore, keeping the well-used brushes for those foul environments is recommended so that investigators don't ruin their favorite brush. In general, crime scene investigators can rotate their brushes for specific tasks so that their lifespan is as long as possible. In summary, brushes begin their life as fine-tuning brushes and cleaning brushes, then are moved to general processing, and finally, they are retired to extremely dirty or body-fluid covered vehicles.

The reason that it is so important to remove all the excess or loose particles of powder from the latent fingerprint is that the powder left behind will cause small circular voids to appear in the tape once it is applied to the fingerprint card. The individual grains of powder will prevent the tape from reaching the surface of the vehicle and leave small voids in the lifted fingerprint. Although one or two small voids found in a lifted print will not be an issue to an examiner, if enough void areas are created then the examiner may not be able to make an identification (Figure 8.10). Sometimes the surface being printed can cause voids to appear in lifted prints, especially in older cars with oxidized paint jobs. The way to tell the difference between voids caused by excess powder and voids caused by the surface being printed is that voids caused by powder will have a small black dot in the middle of the void, which is the grain of fingerprint powder that is causing the void. As a side note, if the void is caused by the surface being printed, the investigator should try lifting the remaining prints with a different choice of tapes. Thicker, gel-style, or "Diff-Lift" fingerprint tapes are ideal for these difficult surfaces.

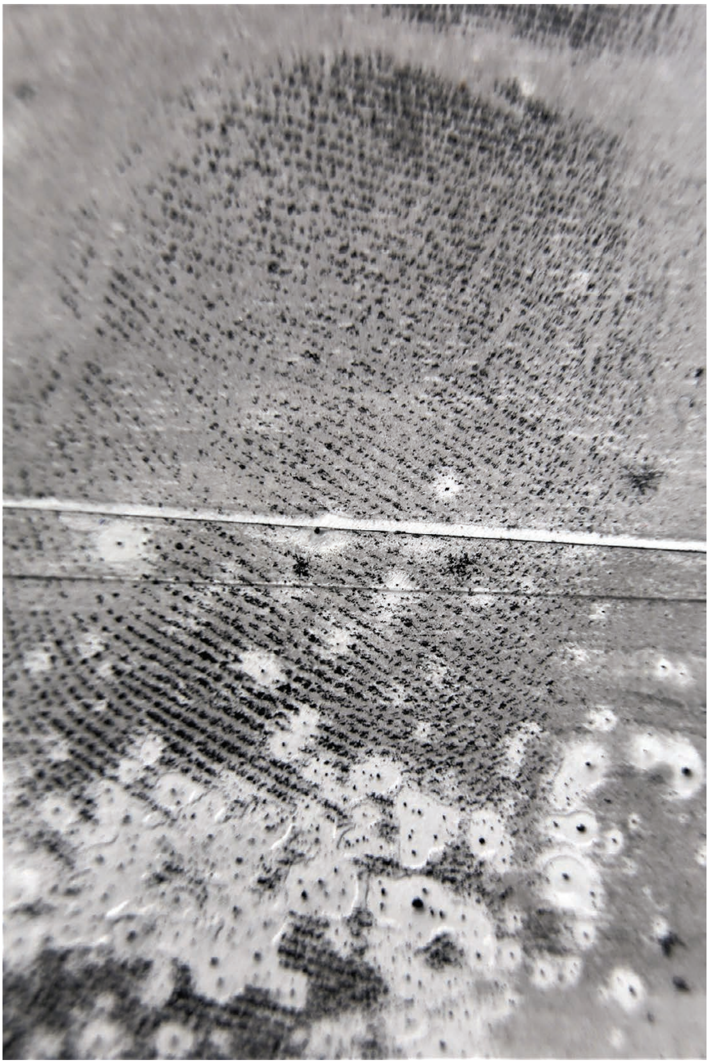


Figure 8.10 Notice the small circular voids on the bottom half of this tape-lifted latent fingerprint. The circular voids are caused by individual grains of excess powder left on the developed fingerprint. In the top half of the print lift, the grains of powder were brushed away so that the fingerprint examiner has the best possible print from which to identify it.

Tape Lifting Fingerprints Developed with Powder

Once the vehicle's exterior has been processed, it is time to start lifting the latent prints with fingerprint tape and adhering them to latent print lift cards. Evidence technicians should have a variety of different fingerprint tapes available to them. Tapes come in a variety of sizes (widths) and construction. In addition, hinge-style lifters of various sizes are also available. Hinge lifters are similar to fingerprint tape, but have been pre-cut to a specific size. Fingerprint tape has one great advantage over hinge lifters and that is it is more flexible. Fingerprint tape allows for flexibility in the size of the tape lift created. Fingerprint tape can be pulled off its roll in small chunks or longer strips depending on the size of the print needing lifting. In addition, larger palm prints can be lifted by laying down a series of layered fingerprint tape strips aligned together. Because of its flexibility, fingerprint tape is an excellent lifting medium and will be discussed in detail. If hinge lifters are an investigator's preference, then understand that the process of applying, smoothing out, lifting, and adhering the lifted latent print onto a lift card is quite similar. Regardless of the style of lifting device chosen by an individual, having two or three varieties of tape will make the investigator's job easier.

Some agencies will have policies in effect that require all fingerprints to be photographed prior to lifting. If this is the case in the reader's agency, then of course they must abide by their policies and procedures. The presence of "visible" fingerprints will always require photographic documentation. For example, bloodstained fingerprints are commonly found on vehicles involved in criminal acts. Sometimes visible impressions can be recovered, but it is not uncommon for those lifting attempts to fail. Therefore, it is imperative that any visible prints or impressions be photographed prior to any lifting attempt. The capture of examination-quality photographs are discussed in greater detail in Chapter 5. The photographic documentation of a vehicle's processing for evidence is a constant endeavor. The investigator's overall documentation will only be benefitted by documenting the steps in processing the vehicle, as well as the recovered evidence. Consequently, even if an agency does not require the photography of developed prints prior to a lift attempt, it is a good idea to photograph the location of latent prints by showing the location of where prints were found by photographing the fingerprint tape attached to the car prior to lifting and adhering to a latent print lift card (Figure 8.11). Photographing the location of latent fingerprints is no different than photographing the location of bullet strikes or the location of other physical evidence inside the vehicle.

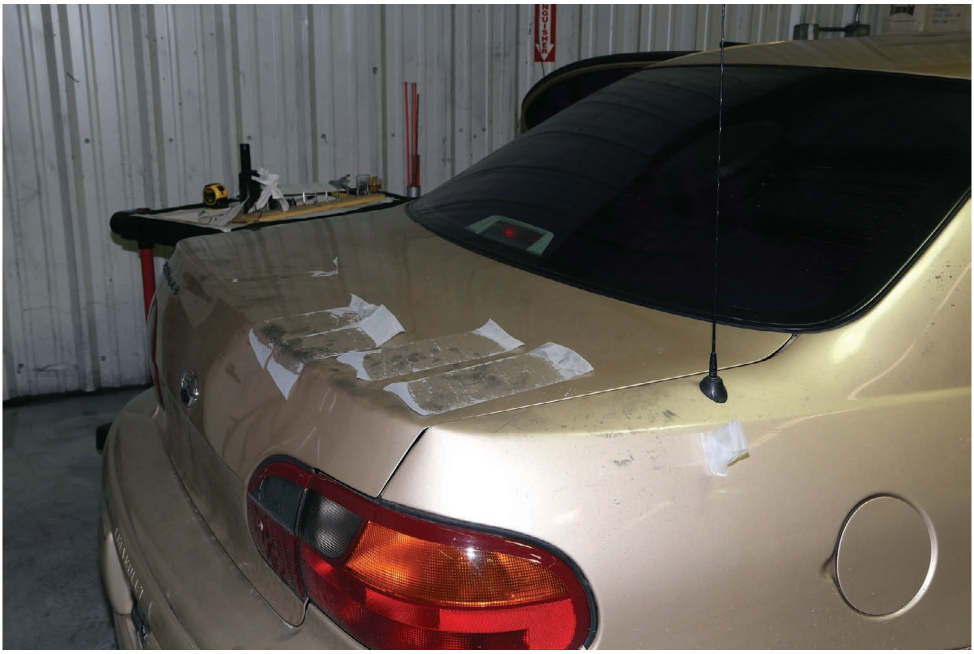


Figure 8.11 The photographic documentation of a vehicle's processing should include the locations of where latent prints were located. These photographs are not designed for identification purposes, but to show where the evidence was found.

The first step in tape lifting is to change gloves and have a fresh-clean pair of gloves on prior to beginning. Powder processing is a messy procedure and one key to a quality print is to lift a clean latent print. As mentioned previously regarding gloves, having two pairs of gloves is advantageous. It is much easier to put on a new pair of gloves over an already gloved hand instead of a sweaty bare hand. Furthermore, if the first pair of gloves are cotton, an investigator may choose to cut off one of the nitrile glove's index fingers. The exposed cotton glove-covered index finger can be used to help smooth out the tape over the vehicle's surface. Once again, consistency is a virtue. Begin at one corner of the vehicle and work around the vehicle in a systematic approach. Jumping around to the "best" prints or getting the "easy" ones first is a recipe for disaster, because something is bound to be missed.

Once a latent print has been selected for lifting, it needs to be cleaned of any excess powder. This is also the time when a print can be "fine-tuned" by ensuring that the print is fully developed so that the greatest amount of print detail results. Evidence technicians and fingerprint processors may not be qualified as fingerprint examiners. Consequently, they should not be evaluating the comparability of a latent print and trying to decide if it is "worth" lifting or not. Always lift the print, even if there are just a few ridge details or minutiae. Even a print with a lack of minutiae can still be used to eliminate a contributor because of the type of fingerprint pattern (loop, whorl, or arch). Another benefit can be found in the courtroom. Showing one's dedication to service and attempting the recovery of all evidence, regardless of quality, will give the jury members a positive opinion of the investigator.

Now that a latent print has been selected, "fine-tuned," and cleaned of any excess powder, it is time to pick a roll of fingerprint tape that is wide enough to cover the entire print. As a note, palm prints and grouped fingerprints will be discussed a little later. For now, the discussion will be centered on the recovery of individual fingerprints. Once a roll of fingerprint tape has been selected, it is time to pull some tape free from the roll. The separation of the tape from the roll should be done in a single, smooth pull. Do not "stage" or stop the removal of tape from the roll trying not to waste any tape. The problem with pulling tape off the roll in stages or steps is that it creates crease lines in the tape that can cause difficulties with the identification of the print (Figure 8.12). In addition, having a little extra tape than what is needed for the print is also advantageous, because it allows room to restart a tape lift if the investigator develops an unexpected wrinkle or is not quite lined up onto the latent print.

The fingerprint processor should have the fingerprint tape roll held in their non-dominant hand and the free end of the tape in their dominant hand. The processor then adheres the freed end of tape onto the surface just below or beside the print. Do not lay the tape directly on the print to start and do not lay it immediately next to the print. By adding just a little bit of space, approximately ½" to 1", this buffer space between where the tape is in contact with the surface and the actual latent print gives the investigator time to restart or correct for possible misalignment or surface texture issues that may not have been originally noticed (Figure 8.13). This buffer space is more important on curved and dented surfaces or where body panels of the vehicle come together. These areas can cause unexpected wrinkles in the tape and the buffer space allows the investigator to start over fresh without disrupting the latent print. In addition, if the investigator begins laying down the fingerprint tape and it develops some unexpected air bubbles that cannot be smoothed out, once again, the extra buffer space allows the investigator to restart and get a better run at the print.

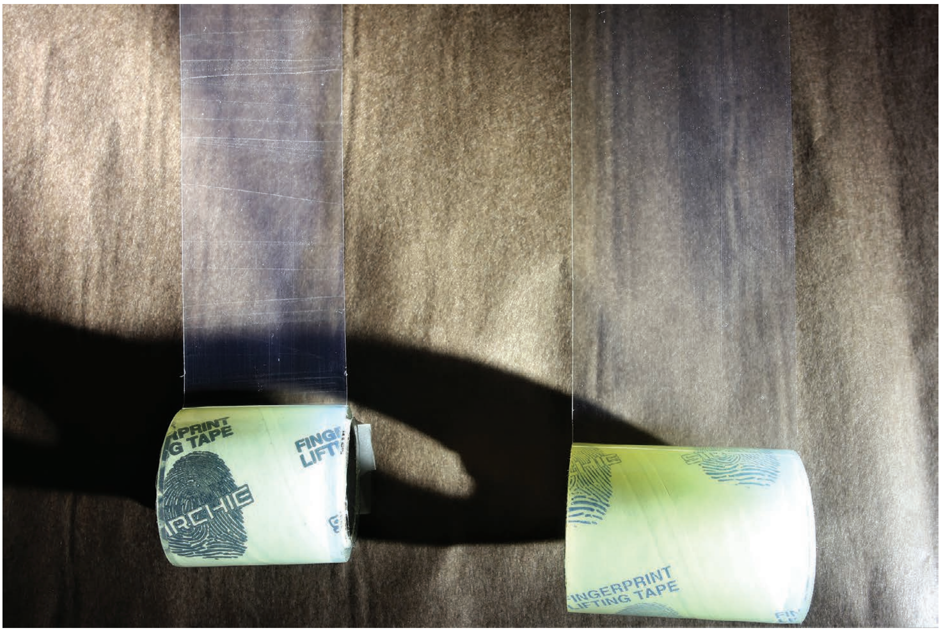


Figure 8.12 The tape on the right was pulled from the roll in one, single smooth motion. The tape on the left was pulled off the roll by stopping and restarting over and over. Notice the crease lines in the tape, which could cause difficulties in making a print identification.

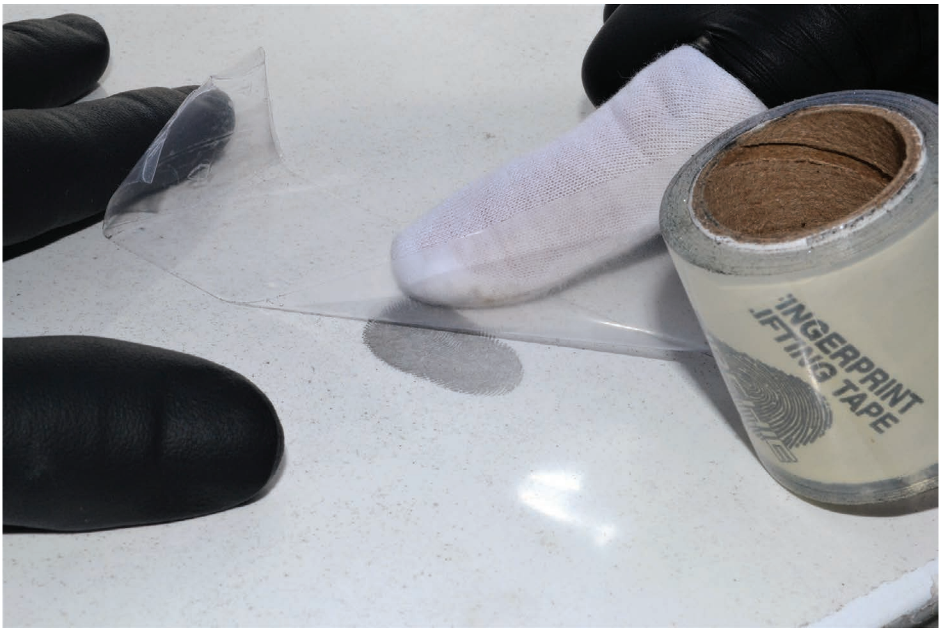


Figure 8.13 The roll of fingerprint tape should be held in the non-dominant hand, while the free end of the tape should be held in the dominant hand. The tape should be laid below or to the side of the print, putting a "buffer" area between the tape and the latent print. This buffer area provides the fingerprint processor the ability to observe that the tape is flat and fully adhered to the surface before reaching the actual print. The benefit is that the processor can restart their attempt if some unexpected wrinkle occurs before the tape is in contact with the print.

The key to getting a quality latent fingerprint lift is to apply the tape over the print smoothly and slowly. There is no rushing when excellence is the goal. With the investigator's dominant hand, press down on the end of the tape and adhere it to the vehicle's surface a short distance away from the latent print. Now, holding the tape onto the surface with the thumb, the pointer finger is used to smooth out the tape and remove any air bubbles. The tape can be pressed down onto the surface with a latex glove hand, but if the investigator has a cotton-gloved index finger exposed, they will have a better feel for the tape because the cotton gloves slide smoother over the tape than nitrile or latex gloves. The non-dominant hand ought to hold the roll of fingerprint tape up and away from the print so that only a small sliver of tape is available to be smoothed onto the surface at any one point of attachment. The tape should not be held so tight as to cause the tape to pull off the surface. The forefinger is then slid slowly from side to side, pressing down the fingerprint tape slowly and evenly across the surface and over the powdered latent print (Figure 8.14). Just to make a note, there is no hard and fast rule about which hand or which specific finger (or thumb) one chooses to use for applying tape onto a latent fingerprint. This will develop for each evidence technician over time, but if one is new to this particular process, then the aforementioned procedure will give them a good starting point.

Air bubbles present in the tape will ruin an otherwise quality fingerprint. Moving slowly and laying down the print evenly by rubbing a finger from tape edge to tape edge will help prevent air bubbles from forming. However, air bubbles sometimes will form regardless of the care performed by the investigator. To help remove the air bubbles, the investigator has a few options. One is to simply rub over the air bubble with a finger. If the air bubble is being stubborn, another effective technique is to use the backside of a fingernail. One does not want to scrape the air bubble, but instead push it to the side edge of the fingerprint tape (Figure 8.15). Crime scene supply companies do sell "Latent Fingerprint Lifting Squeegees" that can assist with pressing out air bubbles, as well as helping smooth out the gel lifters and gel tape. An alternative to the squeegee is the eraser end of a pencil for small areas and a caulking tool for larger surfaces like the gel lifters. A caulking tool is a hard rubber hand tool that is used to smooth out caulk that one uses to seal different types of seams in home construction. Basic fingerprint tapes come in two general styles, clear and frosted. There is absolutely nothing wrong with basic clear fingerprint tape. However, the frosted tape has an advantage. The frosted tint on the tape changes to clear when it has been properly applied to the surface being printed (Figure 8.16). It is easy to see when the frosted tapes have not been applied correctly and the investigator can retrace their steps and smooth out the voids present in the tape.

As the investigator completes the covering of the latent print with the tape, it does not hurt to extend a short distance past the developed print. Most fingerprint tapes are easy to tear. Simply hold down the tape that is resting on the surface with a firmly placed thumb and tear the tape. The gel or thicker type tapes may need to be cut with scissors or a pocket knife, whichever is preferred by the processor. The most important part of finishing off the laying down of fingerprint tape is to "dog-ear" the tape that is still attached to the tape roll. To "dog-ear" the end of the tape means to fold the tape back onto itself so that a tab is created and makes it easier to pull off the next strip of tape. There is nothing more frustrating than trying to pick at a roll of tape and try to get a full width of tape to come off cleanly. Please remember to dog-ear one's tape roll.

When using the 4" wide fingerprint tape to recover latent palm prints or clusters of individual fingerprints, it is extremely important to go extremely slow. Although the

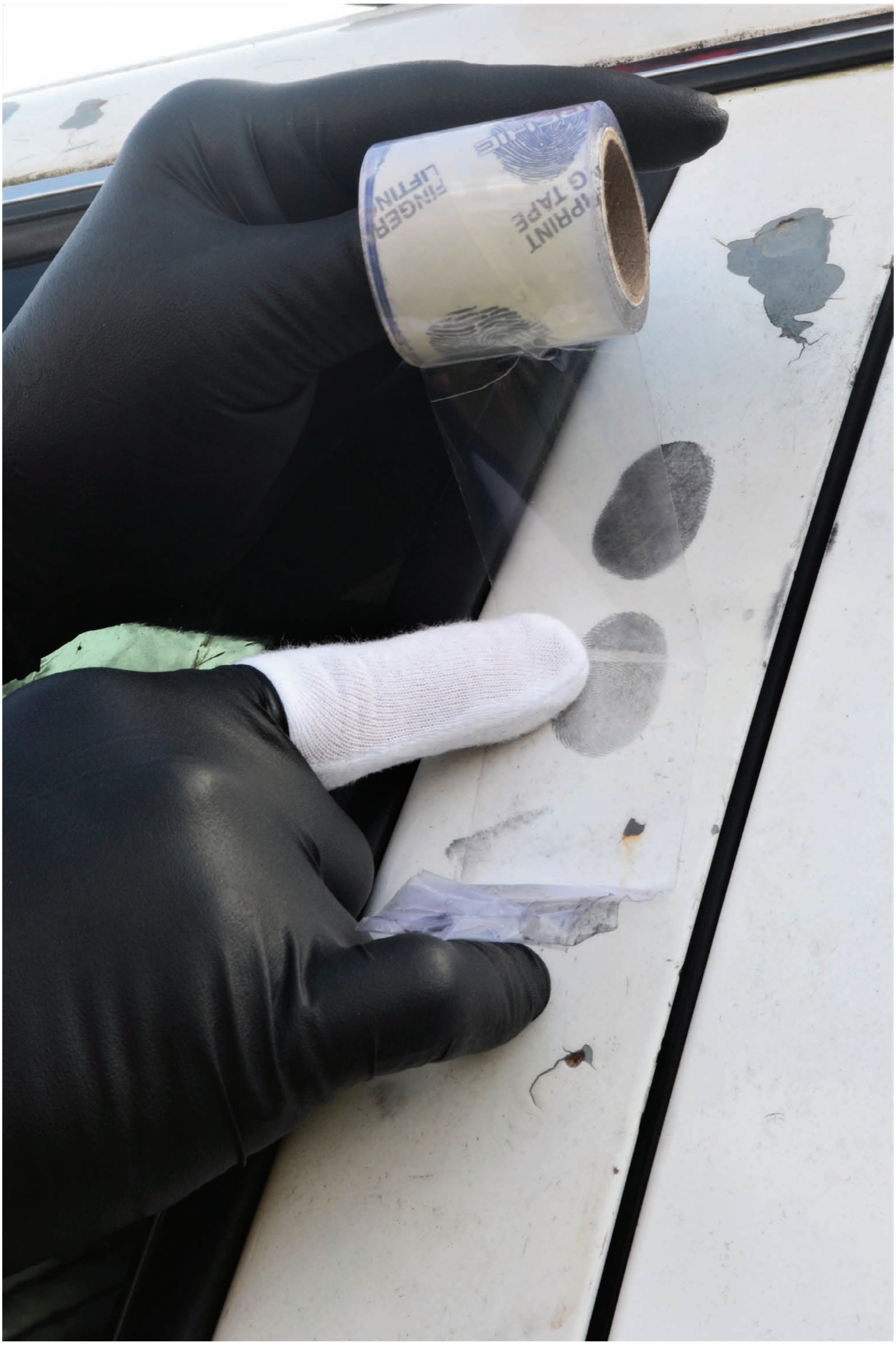


Figure 8.14 The roll of fingerprint tape should be held off the printed surface taught enough so that only a sliver of tape is in contact with the surface at any given moment. The tape is then pressed or rubbed onto the printed surface by sliding the pointer finger side to side and slowly adhering the tape over the powdered latent print.

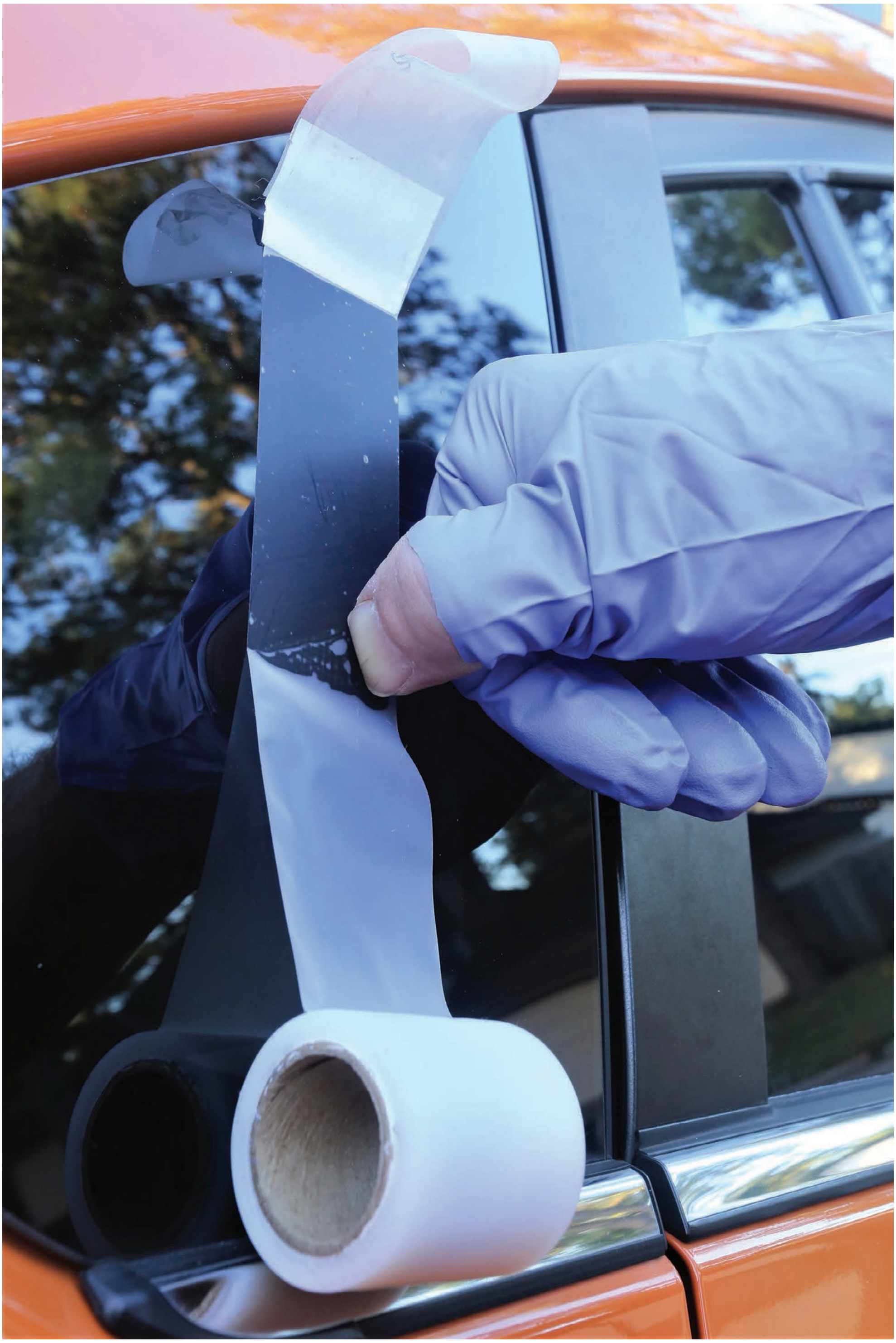


Figure 8.15 Stubborn air bubbles can be removed by using the backside of a fingernail. Do not scrape the nail across the air bubble, because it may cause the tape to tear. The glove can be pulled back or cut to expose the smooth surface of the fingernail and the backside of the fingernail is used to push the air bubble to the side of the tape to release the air.

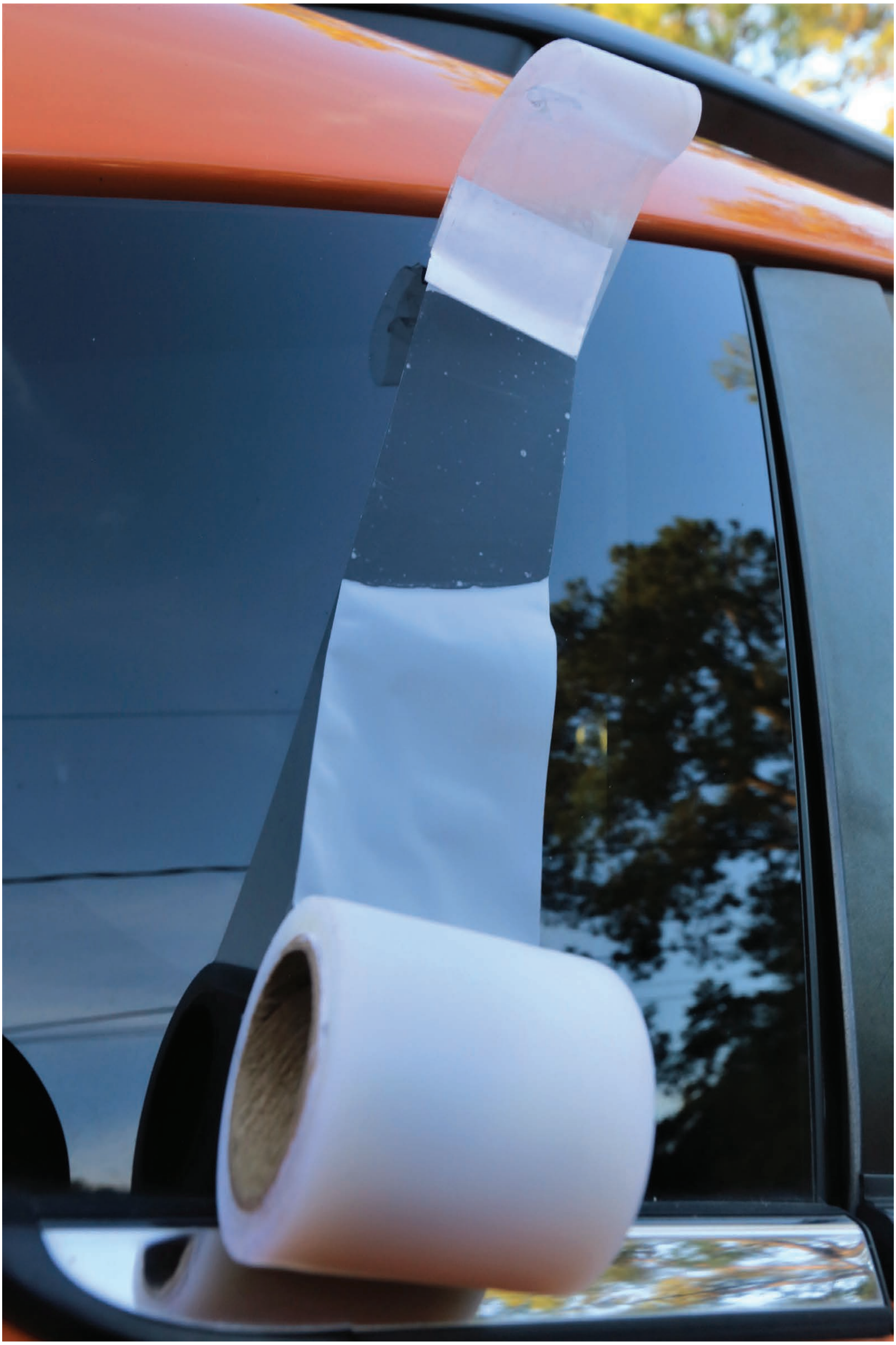


Figure 8.16 Frosted fingerprint tape has the advantage of showing processors where any voids might be present. When the tape has been properly adhered to a surface, the tape becomes clear.

4" tape is extremely valuable because it will cover larger prints, it is extremely susceptible to air bubbles and unwanted creases or folds in the tape. Because the tape is so wide, it easily folds back on itself or falls prematurely over the print causing difficulties lifting a quality print. Therefore, when utilizing the wider tapes, it is extremely important to lay the tape down in very small increments and to hold the tape roll up and off the surface. In addition, when putting down the initial tape contact with the printed surface, consider putting the tape a good 1"–2" before the actual latent print so that the investigator is sure the tape is straight and on a good path to an even adherence over the print. The initial contact with the surface area for 4" fingerprint tape is typically where problems begin. If the investigator can ensure good initial contact to the surface, then the fingerprint lift will have a much greater chance of succeeding. The larger size of 4" tape does not sound like that much of a difference, but it can present difficulties to evidence technicians.

There is an alternative method to the 4" tape and that is to layer 1" strips across the printed surface. The individual strips of tape will overlap each other along the long edge of the tape. Try and keep the strands of tape as straight as possible so that the overlapping portion presents a nice thin seam. The tape can be overlapped by 2–3 mm, but the amount of overlap is not as important as making sure the strips of tape do not separate when pulling them up. On that note, one way to help keep the individual strips of tape together is to lay down a strip of tape as a base. Place a strip of tape below the latent print or prints and start the layering of fingerprint tape from the base across the developed latent print (Figure 8.17).

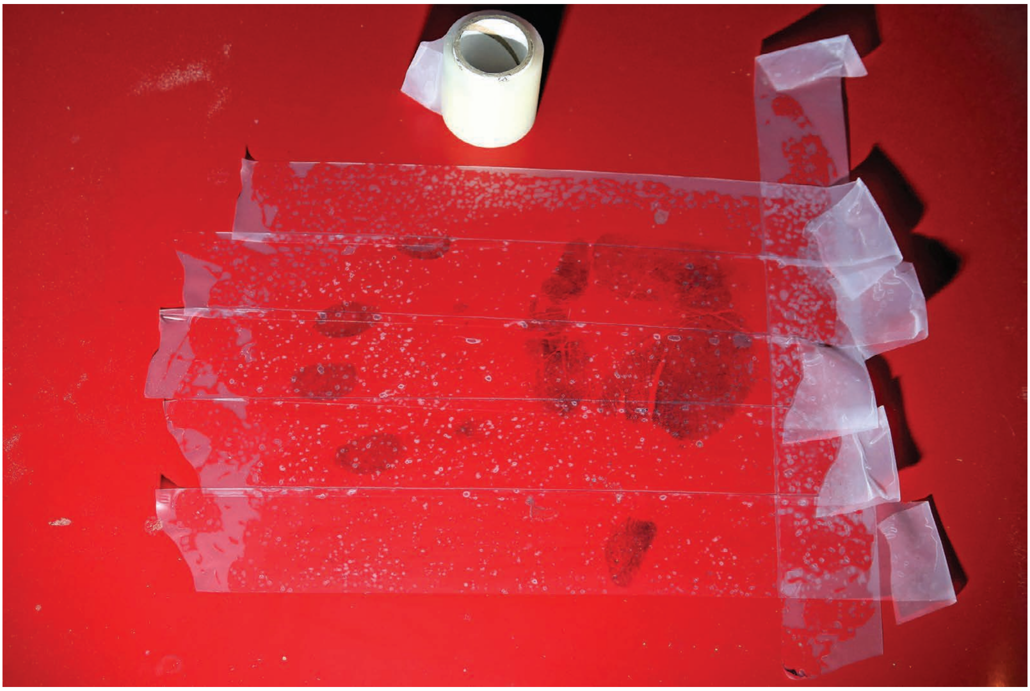


Figure 8.17 Narrower rolls of fingerprint tape can be used to lift larger palm prints or clusters of fingerprints from a surface. The multiple strips of tape are layered across the printed surface to cover a larger area. Notice how each strip of tape has a small "dog-eared" tab at the top. The base strip of tape and tabs help lift the entire print all at once. The side with the bottom-most strip of tape is pulled up first, carefully lifting each subsequent strip of tape in turn.

Do not forget to dog-ear the base strip. This will make the lifting process much easier. In addition, when laying down the tape strips that will be covering the developed impression, place the first strip of tape next to the dog-eared side of the base strip of tape. The first piece of tape laid down will be the first piece of tape pulled up from the surface. Therefore, the technician will want the two dog-eared strips of tape together so that the tape comes up as a single unit and not as individual strips.

All these recovered prints will be lifted off the vehicle's surface and applied to a latent fingerprint lift card. Some agencies will use simple index cards, but the latent fingerprint lift cards that are designed for latent fingerprint processing have a glossy backing to them. The glossy backing makes the fingerprint examiner's life a little easier for making comparisons (Figure 8.18). The glossy backing is similar to what one would find on glossy photographic paper. In addition, latent fingerprint lift cards designed for this purpose typically have the specific identifying case information that a particular agency would like to see on the reverse side. Having the case information boxes preformatted on the lift card helps ensure that the processer does not inadvertently forget a vital piece of information when filling out the card.

If one has dog-eared their roll of tape consistently, the tape applied to the printed surface will have a tab available from which to pull the tape up off the surface. This dog-eared end will be pulled up off the surface and the opposite end will be the anchor of the tape on the printed surface. There are two basic methods to lifting the tape and adhering it to the latent print lift card. One is to remove the entire strip of fingerprint tape and place it on the fingerprint card that is resting on a nearby clean surface, such as the utility cart holding the processor's equipment. The second method is to leave the flat end of the tape anchored to the printed surface and slide the latent print lift (card) against the anchored end (Figure 8.19). Leaving the extra space on either side of the developed print helps in numerous ways. Specifically, this buffer area allows the processor to start laying the tape down onto the lift card ahead of the actual fingerprint and just like the extra space given when laying the print down, the processor can evaluate the process and need be, they can restart the process if the tape begins to fold or air pockets start to form.

Peeling single strands of fingerprint tape off surfaces is pretty much a straightforward endeavor. Peeling layered strands of fingerprint tape can be a bit of a challenge. Remember, the layered strands of tape are used for palm prints or clusters of individual fingerprints. Much like other aspects in latent print processing, investigators should practice lifting layered pieces of fingerprint tape before completing an attempt on a vehicle that is a part of a criminal investigation. Like the single strands, the tabbed ends of the layered tapes will be the ones pulled off the vehicle's surface. Start at the corner where the tabbed end of the base strip of tape adjoins the first piece of tape laid down over the print. The first piece of tape laid down must be the first piece of tape pulled up so that the subsequent layers of tape will lift up subsequently (Figure 8.20). Start lifting the layered tapes at the corner and work toward the opposite side slowly. Once the entire base tape is lifted off the surface, then the tapes can start being lifted from the entire printed surface. Whether the investigator is using the 4" fingerprint tape or multiple layers of narrower tape, the larger surface tends to buckle and fold back onto itself. Consequently, work slowly, do not get into a rush, and maintain control over the tape as it comes off the vehicle's surface. Returning the layered tape to the latent print lift card is the same process, just in reverse. If the strands of tape separate during lifting, they can still be laid seamlessly onto the lift card by laying down the separated strands one at a time, starting with the bottom strand of tape first and working backward toward the last tape adhered to the surface.

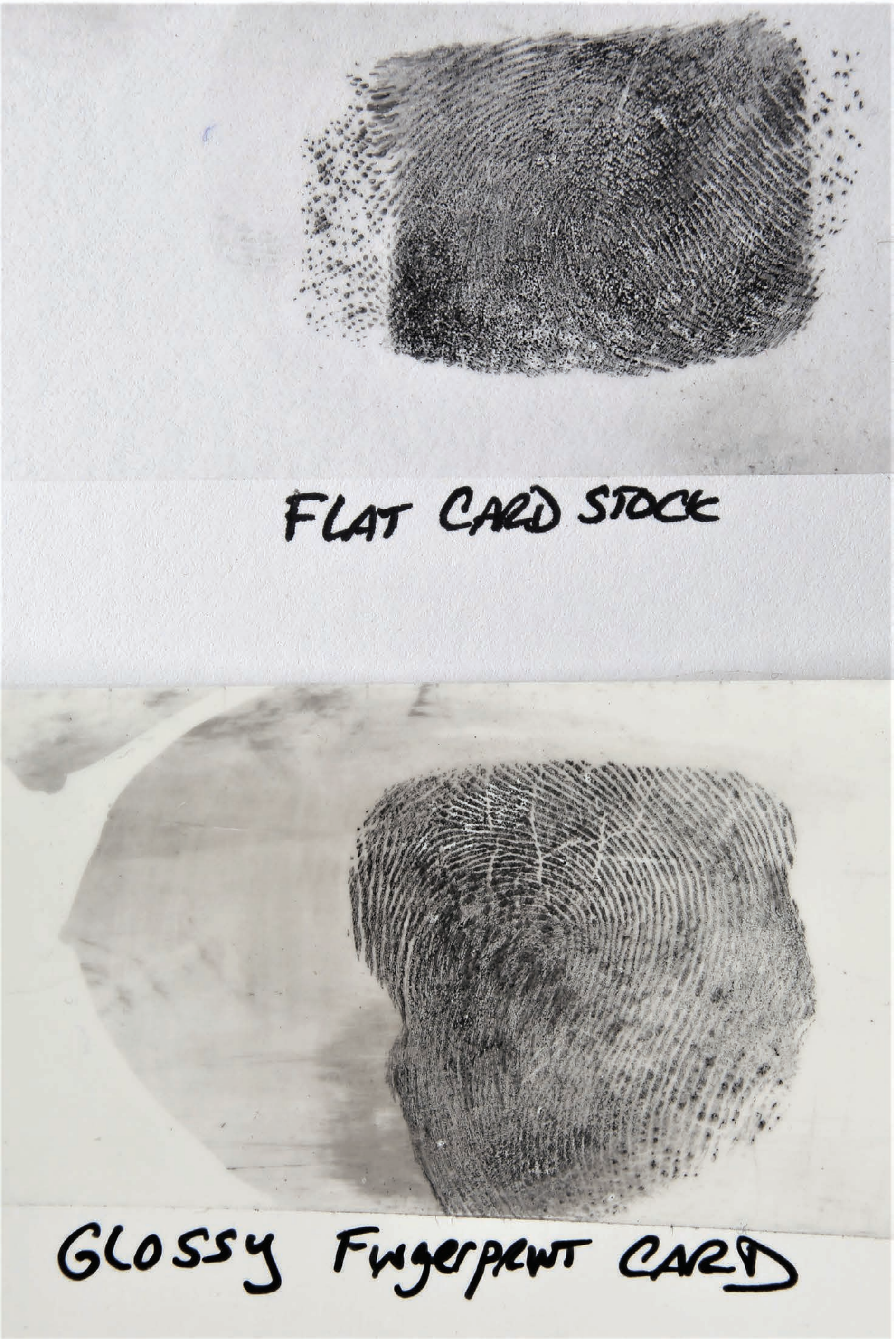


Figure 8.18 Observe the minute difference between the two fingerprint cards. The card on the bottom is a lift card designed for fingerprint processing and has a glossy backing. The card on the top is a plain white index card. The plain white index card makes the print's contrast better, while the glossy backing helps make minutiae more distinguishable. The evidence processor should check with their fingerprint comparison examiners and ask which type of latent print lift cards they prefer.

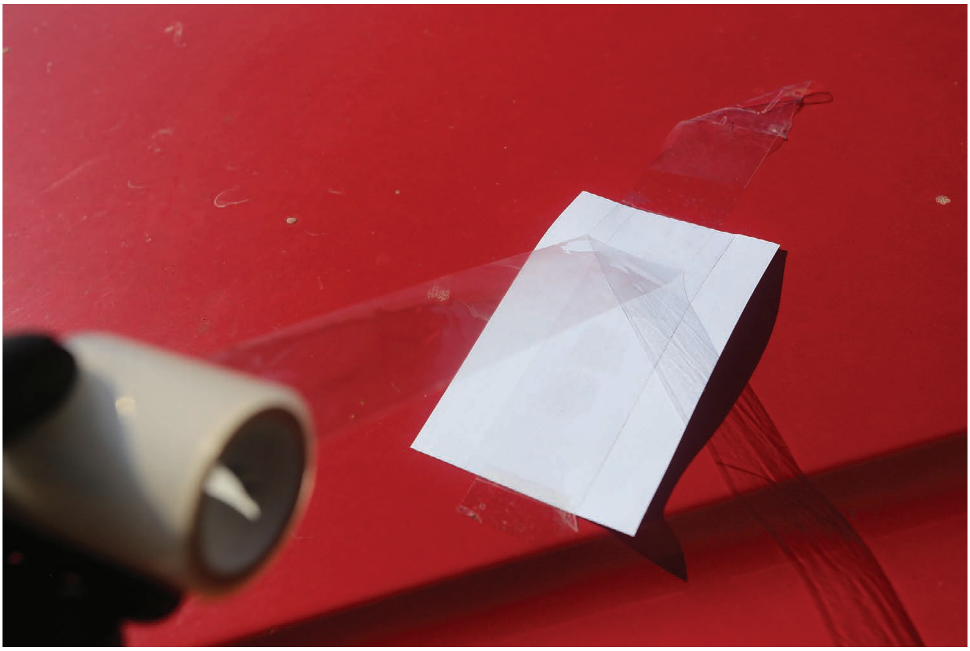


Figure 8.19 Slide the lift card underneath the tape and butt it up against the anchored end of the tape. Hold the free end of the tape off the card and printed surface in preparation to smoothing the tape out onto the latent print lift card, similar to how the tape was placed on the surface originally.

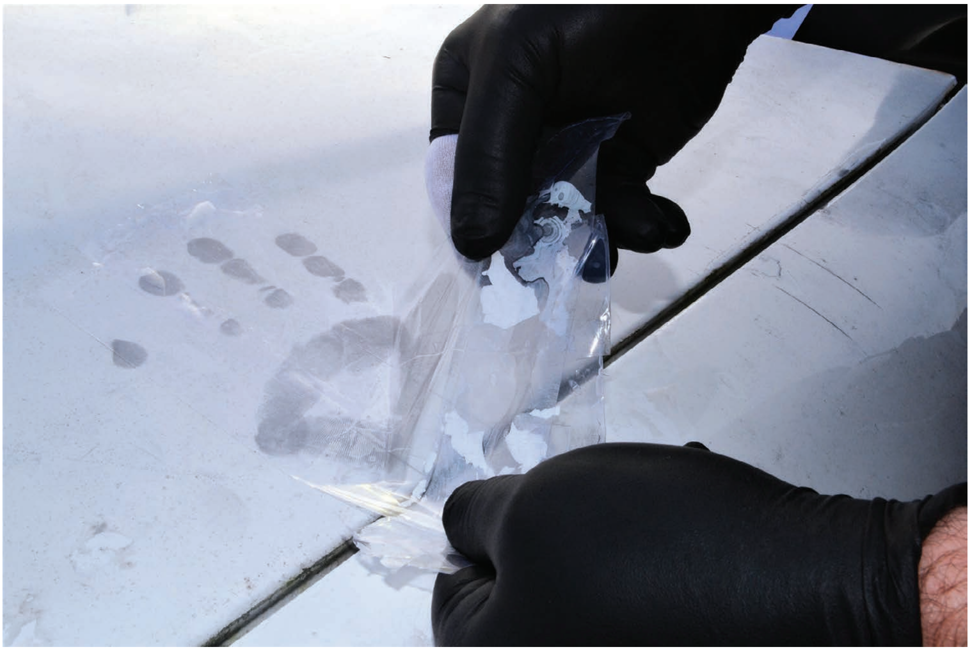


Figure 8.20 Notice how the tabbed ends of each layer of tape are overlapped and each strip is extended over the base strip of tape to help ensure a smooth and single lifting or removal of the palm print. When peeling up the layers of tape, start on the side with the lowest or first strip of tape applied to the surface. This will help remove all the strips of tape as a single unit.

The process of smoothing the fingerprint tape onto the latent print lift card is identical to the manner in which the tape was applied to the vehicle's surface. Progressing slowly and maintaining a smooth pressure across the tape is the key to obtaining a quality lift. While keeping the tape raised above the lift card, the processor should slide their finger from one edge of the tape to the other in small increments and proceed back down the tape until it is laid completely across the latent print lift card (Figure 8.21). If, because of the surface shape or contours, the investigator chose to pull the entire piece of tape off the printed surface, then they will need to attach the flat end (un-tabbed side of the tape, which was laid down on the processed surface last) to the surface bearing the latent print lift card. After that, the process is the same. Smooth out the tape slowly across the lift card by rubbing one's finger from edge to edge down the length of the tape.

Once the print adheres to the latent print lift card, the evidence processor needs to notate the orientation of the print to the surface area. A simply drawn arrow with some sort of descriptor word is all that is needed. The descriptor word should be some type of direction that gives the lifted latent print an orientation to the printed surface, like up, down, forward, rear, top, and bottom. This orientation mark is placed on the same side of the lift card as the lifted print is located (Figure 8.22). The back of the print card will also have documentation and will be discussed later. There is also nothing wrong in drawing a small picture or placing other important information on the tape side of the lift card. Anything that helps the examiner identify the print and the case investigator understand how the

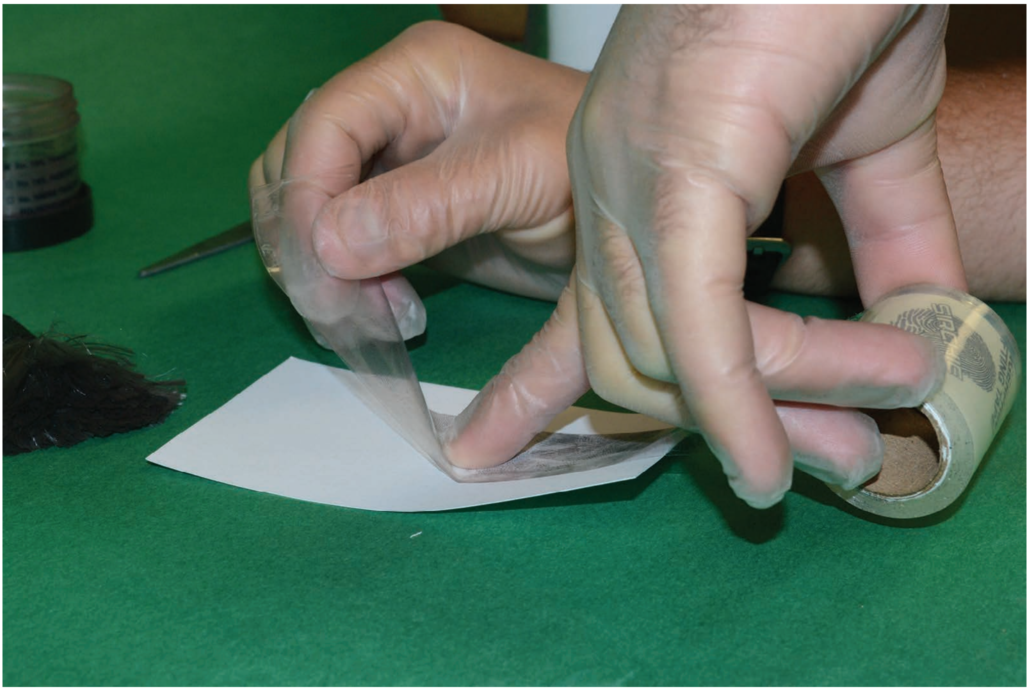


Figure 8.21 A quality lift will have no air bubbles or creases in the tape. In order to keep those from developing, the fingerprint processor should keep the tape from falling prematurely on the latent print lift card and smooth out the tape across the card in small incremental steps down the length of the tape.

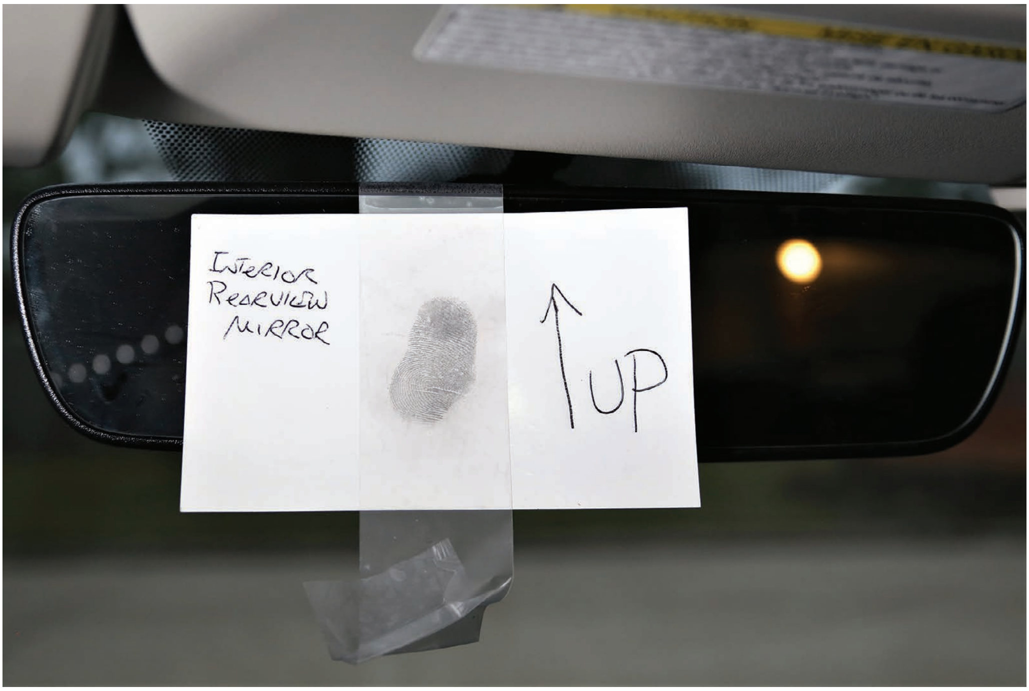


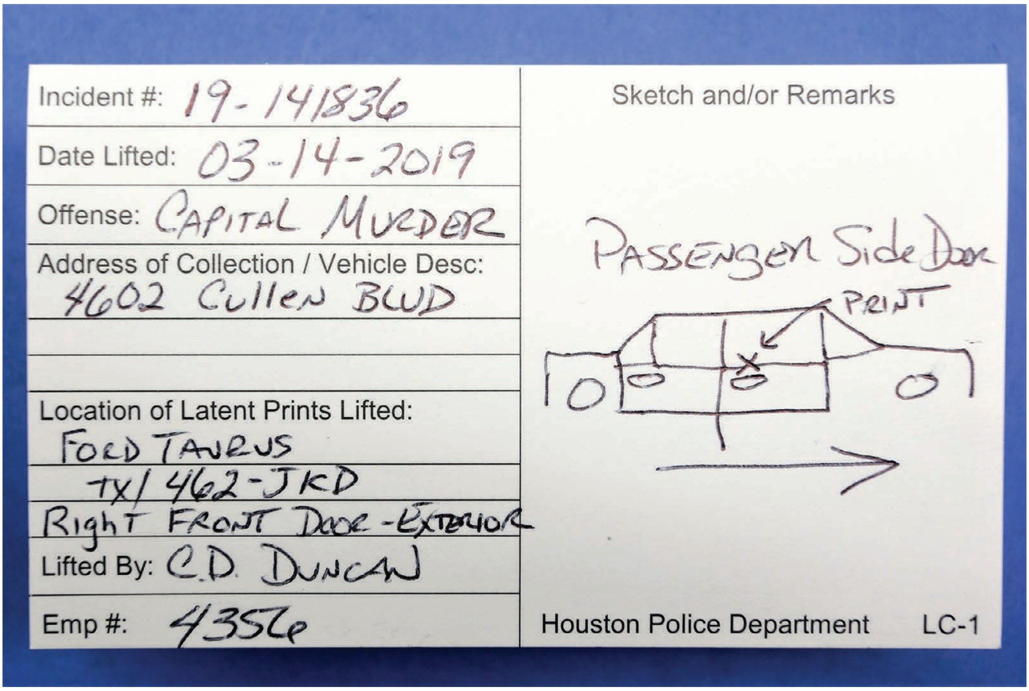
Figure 8.22 It is imperative that the orientation of the print to the surface is placed on the side of the card with the taped latent print. Remember that the orientation arrow and reference (front, back, up, down, etc.) show the relationship of the fingerprint to the surface.

print was placed on the surface is beneficial. For example, if the fingerprints were found on a car door below the window and were oriented pointing upward, then that indicates the door was being pushed closed from the outside. On the flip side, if the fingerprints were found oriented facing downward, then that would indicate the door was pulled shut from the car's interior. There could be other explanations; however, this is valuable information a case investigator can use during interviews and interrogations. It allows the investigator to corroborate or refute someone's explanation as to how their fingerprints ended up on a vehicle.

Once the latent print card is free from the vehicle's surface, it probably will need to have the excess tape trimmed from the lift card. Fingerprint examiners will appreciate a flat, trimmed card to work with. Sometimes a small flap of flat tape can be folded around the backside of the card, but the latent print processor ought not to make it a habit of keeping the excess tape on the card. Without exception, the tabbed end of the fingerprint tape needs to be trimmed away. In the end, the processor wants to submit a clean and well-documented latent print lift into evidence. One more suggestion regarding housekeeping of the latent print lift card is that if the investigator inadvertently leaves his fingerprint on the tape, which is not completely uncommon, then they should circle their own fingerprint that developed on the lift card and put an "X" through it. This tells the examiner not to worry about identifying that part of the latent print lift. The investigator might also wish to put their initials next to the crossed-out print.

The final step in completing the latent print lift card is to place the case information on the back of the card. Each agency will have their own specific case information they desire to have placed on the card, whether it has preformatted boxes or simply is a plain white index card. The one box that will be present on everyone's lift cards will be the description of the surface or object the latent print was recovered from. The examiner should be very clear whether the print was lifted off the interior or the exterior of the vehicle. It is also important to be very clear about the specific location the latent print was recovered from (Figure 8.23). For any latent prints recovered from any vehicle or from an object inside a vehicle, the vehicle's basic information should be included, such as Make, Model, and License Plate Number. The offense report will document other important details, such as the year, vehicle identification number, registered owner, etc., and do not have to be listed on each and every lift card. In addition to a written description of where the latent print came from, the investigation will benefit from having a drawing of the vehicle or object from which the print was lifted. Between the written description, the drawing, and the orientation indicator that is on the opposite side of the card, a clear picture of exactly where the particular fingerprint was recovered is assured. The drawing or brief description of the printed surface should be completed before moving on to the next latent print. All the case information type details can be filled in at a later time, but trying to remember which print came from which part of the vehicle is next to impossible.

The overall fingerprinting process can be completed in several manners. For example, one way is to lay down all the latent print lift tape on all the found prints first and then come back and adhere them onto latent print lift cards later. This is probably the most efficient way to recover the latent fingerprints and will work well in the controlled environments of



Incident #: 19-141836
Date Lifted: 03-14-2019
Offense: CAPITAL MURDER
Address of Collection / Vehicle Desc:
4602 Cullen BLVD

Location of Latent Prints Lifted:
FORD TAURUS
TX/ 462-JKD
Right FRONT DOOR - EXTERIOR
Lifted By: C.D. DUNCAN
Emp #: 4356

Sketch and/or Remarks
Passenger Side Door
PRINT

Houston Police Department LC-1

Figure 8.23 Each agency will have policies or procedures on what information is required on the back of a latent print lift card. The required information is likely to be at least the case number, date of the lift, evidence processor's name, a description of the printed surface, and possibly a simple drawing of the print's location.

vehicle examination facilities. This method of recovering the latent prints is like working on an assembly line, but with just a single processor. One does not have to keep switching tools like tape, lift cards, scissors, and pen after every single print. However, in the field, this methodology may not be possible due to weather. That is why, if possible, it is preferable to complete the processing of vehicles in a controlled environment. Rain and wet conditions will cause difficulty in printing vehicles and although there are wet-processing powders available, they will not keep your print cards dry during a rainstorm. Heat can also pose a challenge to lifting fingerprints. Processing vehicles for latent prints in the outdoor summer sun presents a special challenge. Some tapes will seem to melt on a burning hot vehicle's metal body. If the evidence technician starts pulling up the fingerprint tape and it tears due to the heat, they should stop and find some ice cubes. Rub an ice cube over the fingerprint tape just before lifting and the tape is much more likely to pull free in one piece. In the end, it is just a better decision to process vehicles in the controlled environment of a garage, preferably a climate-controlled garage.

Footwear Impressions and Other Types of Visible Prints

On occasion, investigators will find that a suspect has kicked a vehicle or ran over top of a vehicle during the commission of a crime. Consequently, there will be a need for investigators to recover these footwear impressions. The two main categories of footwear impressions, much like fingerprint evidence, are visible and latent footwear impressions. Visible footwear impressions should be photographed. The photographic documentation of visible footwear impressions is covered in Chapter 5.

Visible footwear and fingerprint impressions should be photographed before an attempt is made to recover them in some other fashion. There are a number of ways to recover visible prints and the method chosen will depend on the medium in which the print has been created. Some prints can be recovered just like a powdered latent print. They can be tape lifted. Obviously, footwear impressions can be quite larger than a palm print and will require larger lift cards. Lift cards are available in 8" × 10" or 8.5" × 11" varieties, but if those cards are not available, an investigator can use a quality piece of "cardstock" or heavyweight printer paper. These papers come in a variety of white tones, therefore, pick a bright white and glossy finish paper. If the investigator does not have a large enough lift card, they can overlap the cards to cover the entire footwear impression. Once the footwear has been lifted and placed onto the overlapping print lift cards, the backsides of the cards should be taped together, so that both sides of the overlapping cards are sealed together. This will help prevent damage to the print caused by the cards coming apart. Evidence technicians should also keep some black glossy cardstock or fingerprint lift cards in stock. These cards will become useful when a footwear impression or handprint is created by a light-colored medium, such as tree pollen or drywall dust.

Larger "gel lifters" are also a great tool to recover visible footwear and handprint impressions. Tape lifts work well when the impression is created with fine particles like pollen and dust, but do not work well with bulkier particles like dirt and mud. Gel lifters, on the other hand, work better with grittier or larger particles left behind on a vehicle's surface. Gel lifters also come with black and white backings so that a contrasting color can be chosen based on what color debris the impression has been created with. Gel lifters are typically applied to a visible impression holding one edge of the gel lifter

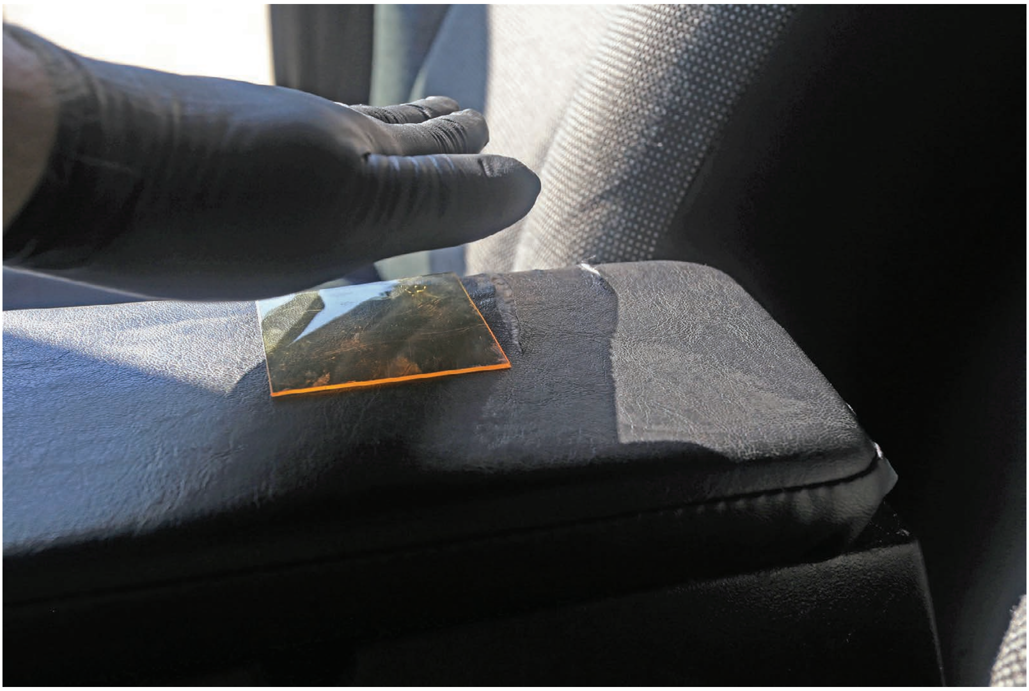


Figure 8.24 Gel lifters typically get better results if they are pressed firmly onto a surface with limited side to side or lateral movement. Gel lifters are an excellent choice when choosing a lifting medium for textured surfaces, such as the center console in this vehicle.

on one side of the impression and rolling the lifter across the impression. Gel lifters generally result in sharper clarity if the impression is "pressed" into a gel lifter and not rubbed into it like tape onto a fingerprint. Consequently, the investigator should use something flat, like a wood board, and apply firm and constant pressure across the entire board and gel lifter, while avoiding any sliding motion that may cause the impression to blur (Figure 8.24).

Processing the Vehicle's Interior for Latent Fingerprints

Processing a vehicle's interior is a greater challenge to evidence technicians than processing the vehicle's exterior for latent print evidence. This is because the interior of the car will have almost every conceivable type of surface: metal, plastic, rubber, glass, vinyl, leather, etc. In addition, these surfaces can be curved or flat, textured or smooth, porous or nonporous, and fingerprints can be tucked into very hard-to-reach recesses. As a result, processing the interior of a car is more difficult and requires additional thought, tools, and techniques. Even beyond all these challenges, investigators also have the potential of having to fingerprint anything that may be of evidentiary value inside the vehicle. Because of the vast number of evidentiary items that might be found inside of a vehicle, this book will concentrate on the vehicle itself. However, that does not exempt an examiner from having to fingerprint items found in the car that are reasonable to expect that they were handled by a suspect.

The processing of the vehicle's interior occurs after the vehicle's exterior processing has been completed and the interior of the vehicle has been thoroughly photographed. The procedure for processing the vehicle's interior is similar to the exterior's processing. Excluding weather or other unforeseen circumstances, it is advisable to powder process the entire vehicle's interior before setting out to tape lift the developed fingerprints. The general processing of the vehicle's interior should be from the outside inward. Another general concept to keep in mind while examining vehicles for evidence is that just because it may save time to skip the processing of certain interior components because of the small chance of obtaining a print worthy of identification, that does not justify complacency in one's work. Investigators should be encouraged to do what is difficult and maybe they can find that one clue that no one else could. A strong, meticulous work ethic is needed when processing vehicles, especially the interior of a vehicle.

Keeping with the theme of maintaining a consistent processing procedure and working from the outside in, the first area that ought to be powder processed are the interior sides of the doors and door frames (Figure 8.25). This is an often-overlooked area when processing vehicles for fingerprints. It should not be, because the paint is protected from sun exposure and dirt for the most part and is often a clean and smooth surface from which to locate and recover latent prints. The interior side of the door's window and door panels can be processed next. The door handles are typically the most likely surfaces to contain quality latent prints, but if the door has those smooth wood panel insets, those too will hold exceptional fingerprints. Each of the car doors should be powdered in a similar, systematic way before moving farther into the vehicle.

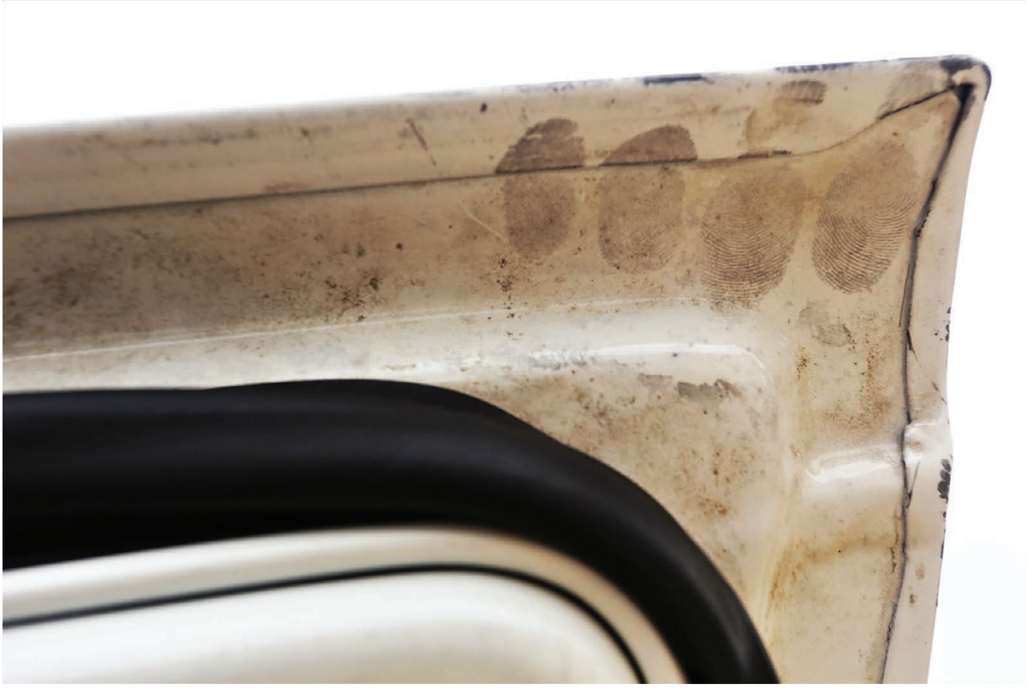


Figure 8.25 An area often overlooked when processing a vehicle for latent fingerprints is the interior sides of the doors and door frames. These surfaces are frequently cleaner than the car's exterior, because they are protected from weather and incidental contact. In addition, suspects tend to wipe down stolen cars, but may forget to wipe down these areas when leaving a stolen vehicle behind, thereby making it a great surface from which to recover latent fingerprints.

Moving farther into the vehicle, it is advisable to break the interior up into quadrants to maintain a more methodical approach. For the sake of argument, begin with the driver's compartment and work around the car until the interior of the car is completely processed. Key areas that should be specifically examined for latent prints include:

- Seatbelt buckle
- Rearview mirror and vanity mirrors present on the sun visors
- Radio and temperature controls
- Driving controls, such as the gear shift and turn signal arm
- Touch-screen controls
- Any other smooth surfaces that are likely to possess latent fingerprints

The recent addition to touch-screen amenity controls on vehicles has added a whole new surface for investigators to examine for latent prints inside vehicles. Of course, many suspects wear gloves during the commission of crimes, but these touch-screen controls do not always work with a gloved hand. Consequently, they provide an excellent source for potential evidence, including DNA and fingerprint evidence. These screens are very easy to see latent (unprocessed) prints with the use of oblique lighting and if the fingerprints are clearly swipe marks, then it may be advantageous for the investigator to process the touch screen controls for DNA evidence instead of latent prints.

As the evidence technician works around the interior of the vehicle, they are looking for those clean, smooth surfaces that are more likely to contain latent fingerprints. However, there are other surfaces inside the car that might also possess fingerprints, but are not generally processed because they are textured. Textured surfaces do offer a challenge to investigators, but they do not eliminate the potential for the recovery of latent prints. Textured surfaces can range from dashboards and door panels to leather or vinyl seats. There are a number of products sold by crime scene supply companies designed to assist investigators with the recovery of latent fingerprints from textured surfaces. The gel-style lifting tapes are beneficial on surfaces where the texture is not as deep, such as leather or vinyl seats. Textured surfaces on door panels and dashboards are typically more ingrained because the manufacturer is desiring a surface that will hide fingerprints. The more textured surfaces are better processed with silicone putty, such as AccuTrans™.

AccuTrans is a silicone material that is extruded through a mixing gun and spread across the surface. As the silicone spreads across the textured surface, it fills in all the crevices and textures. Once the silicone dries, it can be pulled off the surface and hopefully it will have a smooth and even-leveled print on it. AccuTrans and similar products can be a little expensive as a personal purchase. A less-expensive alternative is to use Elmer's Blue Gel Glue™. Other glue manufacturers also produce blue gel glues, but they do not work as well as the Elmer's brand glue. In addition, Elmer's makes a green-colored glue, but that too does not work as well in latent print recovery purposes. Therefore, the Elmer's blue-colored gel glue is the preferred gel glue of choice.

When working on textured surfaces inside the car and a print is developed with powder, lifting that print with standard fingerprint tape is likely to be inadequate. The tape just cannot get into the crevices of the texture to pull out the print details (Figure 8.26).

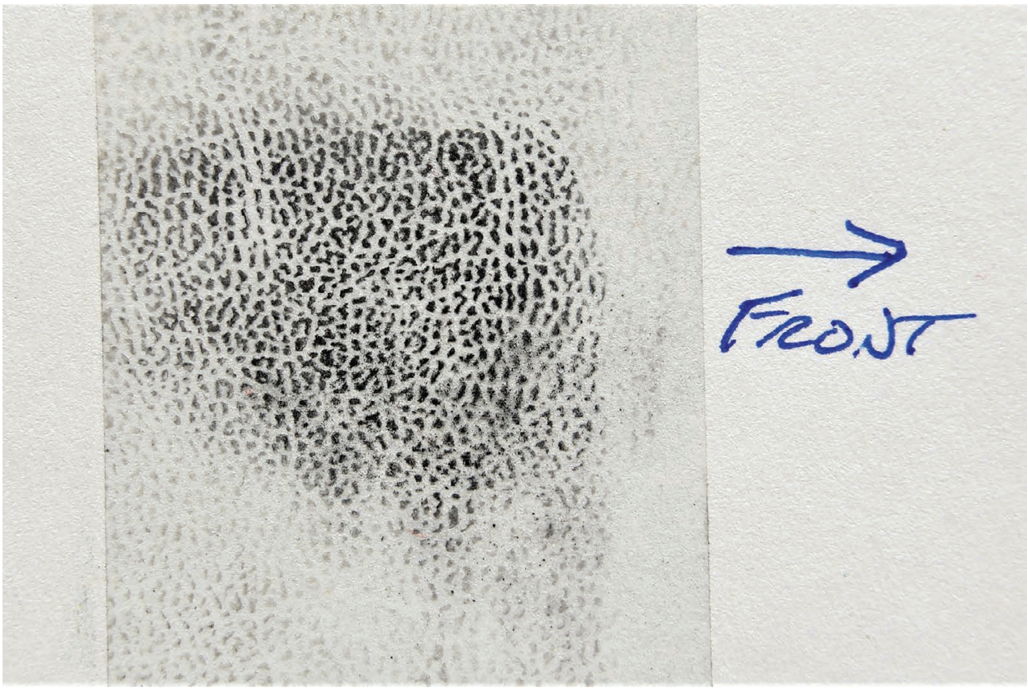


Figure 8.26 Fingerprinting textured surfaces can be a challenge. This "print" was lifted off the center console of a vehicle. Notice how standard fingerprint tape lifts the texture pattern of the vinyl instead of the fingerprint's ridge detail. This occurs because of the two (or more) layers of surface and the tape only being able to lift print's ridge detail that is resting on the upper most portion of the surface.

Forensic supply companies have a wealth of options to help lift textured prints. However, not all investigators have the same resources and funding. The gel-glue trick is an inexpensive option for investigators. To start the process, the investigator should cut a small piece of an index card, approximately 1" × 3", but the size does not have to be exact because it will simply be used to help lift the glue off the surface. Do not throw away the leftover part of the index card. It will also be utilized in the process. Set the piece of cut index card adjacent to the developed print. Next, drizzle the gel glue onto the card and across the developed print. The dollop of gel glue should be contiguous over the index card and the developed print. The developed print is simply the processed print found on a textured surface. One may find that magnetic powder works well on the textured surfaces of a vehicle's interior. Take the leftover part of the index card and use it as a squeegee and flatten out the gel glue to a nice even and consistent thickness (Figure 8.27). One does not want to spread the glue too thin. Leave approximately 2–3 mm of glue on the surface. Remember to be sure to cover the print and the lift tab that should have been laid down next to the developed print. It may take the glue as much as 24 hours to fully dry, but that time can be lessened by using a hairdryer and blowing hot air across the surface. After allowing the gel glue to dry, lay down a strip of fingerprint tape over the dried glue. The fingerprint can now be peeled up from the surface by the tab created by the index card and the fingerprint tape. The lifted print is placed onto a latent print lift card similar to any other latent print lift (Figure 8.28).

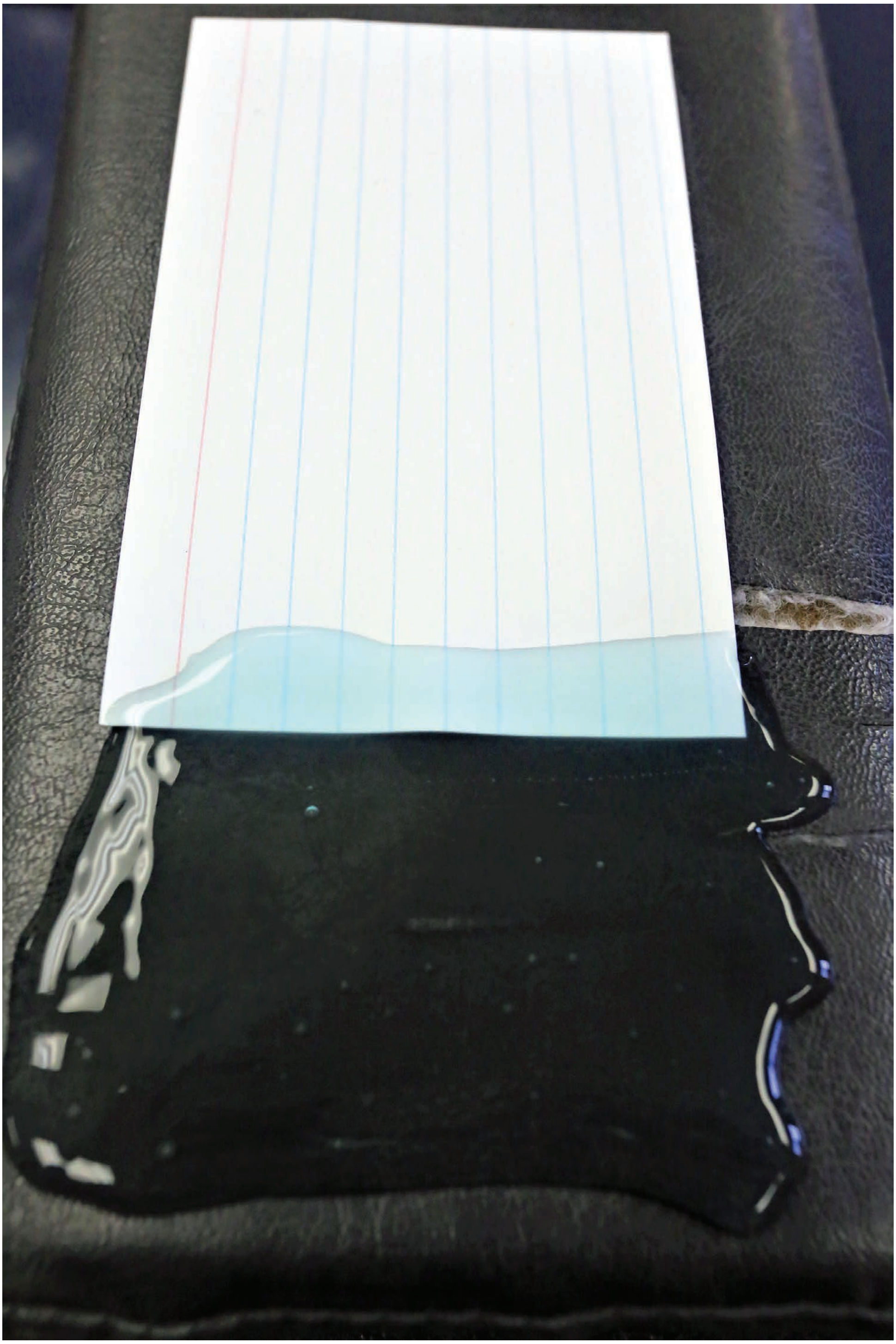


Figure 8.27 Squeeze out the Elmer's Blue Gel Glue to an even thickness of approximately 1–3 mm in thickness across the entire print. The glue must be Elmer's Blue Gel Glue. Place a small piece of an index card along one edge of the print and make sure the glue spreads across both the developed print and the index card. The index card will be used as a tab to lift the latent print from the surface.

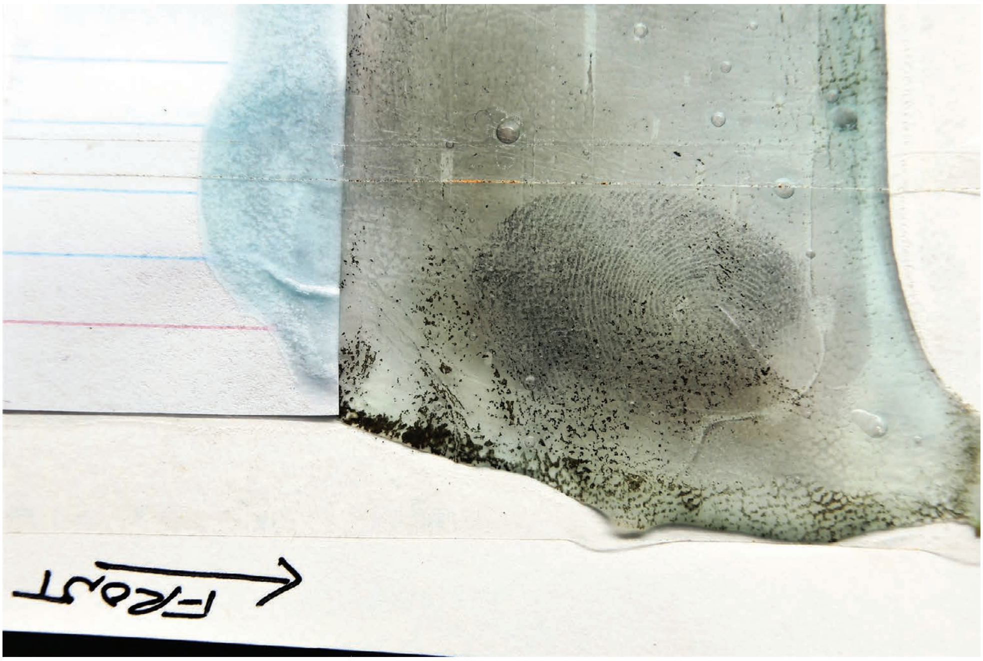


Figure 8.28 When the gel glue is allowed to dry, then it can be covered with fingerprint tape and lifted. This figure shows a print lifted off the same center console as Figure 8.26, but in this image, the glue was allowed to pull out the ridge detail from all the crevices on the textured surface and allows the examiner to see the full latent print left behind on the surface.

Many fingerprint processors have experience with cyanoacrylate or Superglue® fuming techniques. Cyanoacrylate fuming has a number of advantages when processing objects for latent fingerprints. The major advantage is that the thin layer of cyanoacrylate that forms over a latent fingerprint protects it from being damaged during the process of powdering and lifting. Even better than protecting the fingerprint is that an evidence technician can attempt to lift the latent print multiple times and still obtain a quality lift. This can be of great benefit to a vehicle examiner because of all the curved and textured surfaces found inside a motor vehicle. Fuming the inside of a vehicle is easier than fuming the outside of a vehicle. There are “Fuming Wands” that cast cyanoacrylate fumes over a surface, but in the past, there have been safety concerns for the user. Cyanoacrylate fumes bond to moisture and when fuming wands are used outside of a sealed container, they can bond to the moisture in one’s eyes, causing everything from irritation to the bonding of contact lenses to the eyeball. Even worse, if cyanoacrylate is overheated to approximately 220°, it produces hydrogen cyanide gas, which can be fatal. Consequently, using fuming wands is not recommended. A vehicle would have to be tented or covered with a mostly airtight plastic-sheeting type of tent. However, cyanoacrylate fuming is still an excellent tool for investigators and fuming the interior of a vehicle is a real possibility.

Fuming the inside of a vehicle is still a much larger enclosed container than a standard-sized fuming tank. Therefore, a greater volume of cyanoacrylate ester is necessary to fume the interior of a vehicle. In addition to the added volume of the chemical needed, the fumes must be circulated around the vehicle's interior. This can be done with the help of a small battery-powered fan that can be placed next to the fuming cyanoacrylate and it will circulate the

Figure 8.29 HotShot™ and Cyano-Shot™ cyanoacrylate fuming developers can be used to fume the interior of vehicles. An evidence technician should use several developers per vehicle and allow 30–45 minutes for the fuming of each vehicle. Adding a small fan to the equation will help circulate the cyanoacrylate fumes throughout the vehicle.

fumes around the vehicle. For cyanoacrylate fuming to be effective, the environment should have between 70% and 80% humidity. This can be problematic in an air-conditioned garage. If the outdoor environment allows, the vehicle could be fumed outside and then returned inside the vehicle examination building to complete the vehicle's processing. Another alternative is to use a self-contained cyanoacrylate fuming pack. One such device is known as a HotShot fingerprint developer. The great advantage this developer kit has is that it produces the steam, otherwise known as humidity, along with the cyanoacrylate fumes, which means that it can be utilized in an air-conditioned examination facility (Figure 8.29). HotShot recommends using three to four developer packs for a passenger car's interior and the fuming should be allowed to continue for 30–45 minutes. Because the fumes and steam rise, one should place the HotShot packs on the vehicle's floorboards and not forget to assist the fumes by providing a small fan to help circulate the fumes throughout the vehicle. When the vehicle is opened up for the first time, it is recommended to open the garage bay door to allow the fumes to escape freely and give the vehicle enough time to adequately ventilate.

Printing a Vehicle's Tires

There will come a time when an evidence technician will be asked to collect a set of known tire prints from a vehicle in the hopes of matching the known tire prints to a set of unknown tire impressions recovered at a crime scene. The process of rolling a tire is similar to recording the palm prints of an individual before the days of automated digital capture of fingerprints. Applying ink to a vehicle's tires is not any more difficult than rolling a set of palm prints. Tires are just a much larger surface. Rolling a tire's print is typically done on butcher paper because of the length of the tire's full print. To begin the process, an evidence examiner might want to know how much butcher paper will be needed to roll a full tire's impression. Going back to a high school geometry class, the formula to know the circumference of a circle (tire) is $2\pi r$ or πd, where r equals the radius or d equals the diameter of the wheel. Remember, that the measurement of a vehicle's wheel is not just the rim's diameter, but the full diameter of the wheel and tire. For example, an average passenger car's tire was measured to have a 28" diameter and the investigator wants to know how much butcher paper will be needed to collect a tire's full impression. The calculation for this determination is as follows:

- Formula: πd (or $2\pi r$)
- Tire's diameter (d) equals 28"
- $28 \times \pi$ (or 3.14)
- $28 \times 3.14 = 87.92$ (rounded to 88")
- 88" equals 7'-4"

In this example, the circumference of this particular passenger vehicle's tire is 7'-4" and to be on the safe side, an investigator will want to roll out approximately 8 feet of butcher paper and enough room to roll a vehicle across 8' of floor.

The investigator will need some fingerprint ink, an ink roller, and an ink slab or plate to complete this process. Besides the butcher paper, the investigator may need one more item that can be beneficial for those facilities where the floors are not perfectly smooth and that is a couple of large cardboard boxes. The boxes are cut open and laid flat across the floor's surface where the vehicle is going to be rolled across the floor. The butcher paper is laid on top of the flattened boxes to provide a smoother surface for the print to develop on. The evidence technician should position the vehicle at one end of the rolling surface and sweep the area in front of the vehicle's tire to remove any debris that might affect the tire's inked impression. The specific tire that is going to be printed needs to be jacked up off the floor. The opposite end of the vehicle's tires should have wheel chocks placed under them so that the vehicle cannot roll away. The vehicle should then be placed in neutral and the emergency brakes disengaged. This should allow the vehicle's wheels to rotate freely, so that the ink can be more easily applied to the tire. The wheel should be cleaned of loose debris. An air compressor with an air blower attachment is an excellent tool for this process. If one is not available, then a soft-bristled brush can be used to clean the wheel of loose debris.

The next step is to place ink on the tire. Fingerprint ink is placed on the ink slab and rolled out to a thin even coat with a fingerprint ink roller. In turn, the ink roller receives a nice smooth layer of ink and the ink roller is then rolled over the surface of the tire. This process will be time consuming because of the sheer surface area of the tire. The evidence examiner will alternate between retrieving ink from the ink slab and rolling ink across the tire until the full circumference of the tire has an even coat of ink over the entire tire's outer surface or as even a coating of ink as possible [Figure 8.30(a)]. Once the ink has been applied to the tire, it can be lowered down onto the end of the butcher paper. Another option would be to remove the tire from the vehicle and roll it across the paper by hand. Either way is acceptable, but the weight of the car does help ensure that the ink from the tire is transferred to the paper. Preferably, the evidence technician has someone to help roll the vehicle across the butcher paper. The vehicle can be carefully and slowly driven across the paper or pushed, but driving the vehicle is much easier. One person should keep the tire rolling straight by holding the steering wheel steady and one person outside of the vehicle making sure the tire stays on the butcher paper.

Obtaining inked impressions from a tire is more difficult than inking someone's fingerprints. There are a few helpful hints to ensure better results. First, one should have a smooth, clean floor in which to roll the tire. If one's impressions are not coming out dark enough, they may try placing a thin piece of smooth, soft material like foam or fabric underneath the paper to help the ink transfer to the paper. In addition, the butcher paper might stick to the tire as it rolls and the individual outside the vehicle may have to stand or walk on the paper just behind the tire being printed to keep the paper from wrapping around the wheel. In addition, the inked impression left behind on the butcher paper may have to be rolled up toward the end of the impression so that the trailing wheel does not roll across the inked impression and ruin it. Once the tire has completely rolled the full circumference of the tire, the butcher paper should be pulled up and set aside [Figure 8.30(b)]. Do not forget to mark the butcher paper with the identification of which tire it was that was rolled across the paper. Eventually, all the case information will be placed on the butcher paper, but that can wait until the other tires have all been rolled. After all tires have been inked and their impressions recorded, then each length of butcher paper can be marked with all the pertinent case information. The sections of butcher paper can finally be rolled up loosely and packaged in a protective box for submission into evidence.

(a)

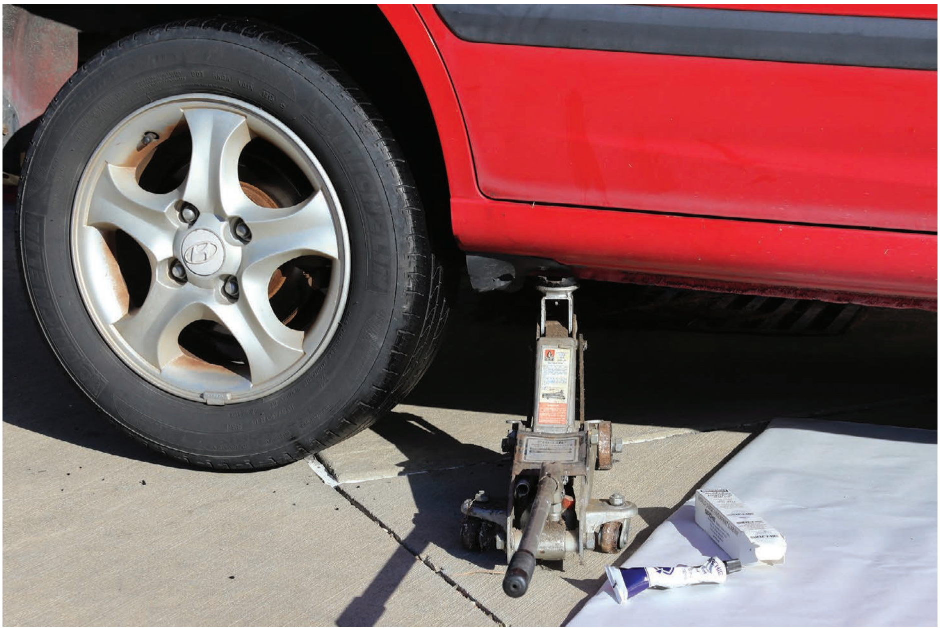


Figure 8.30 (a) An evidence technician is preparing a tire for the collection of an inked tire impression. The key to a quality impression is to place an even coat of ink across the tire's entire exterior surface.

(b)

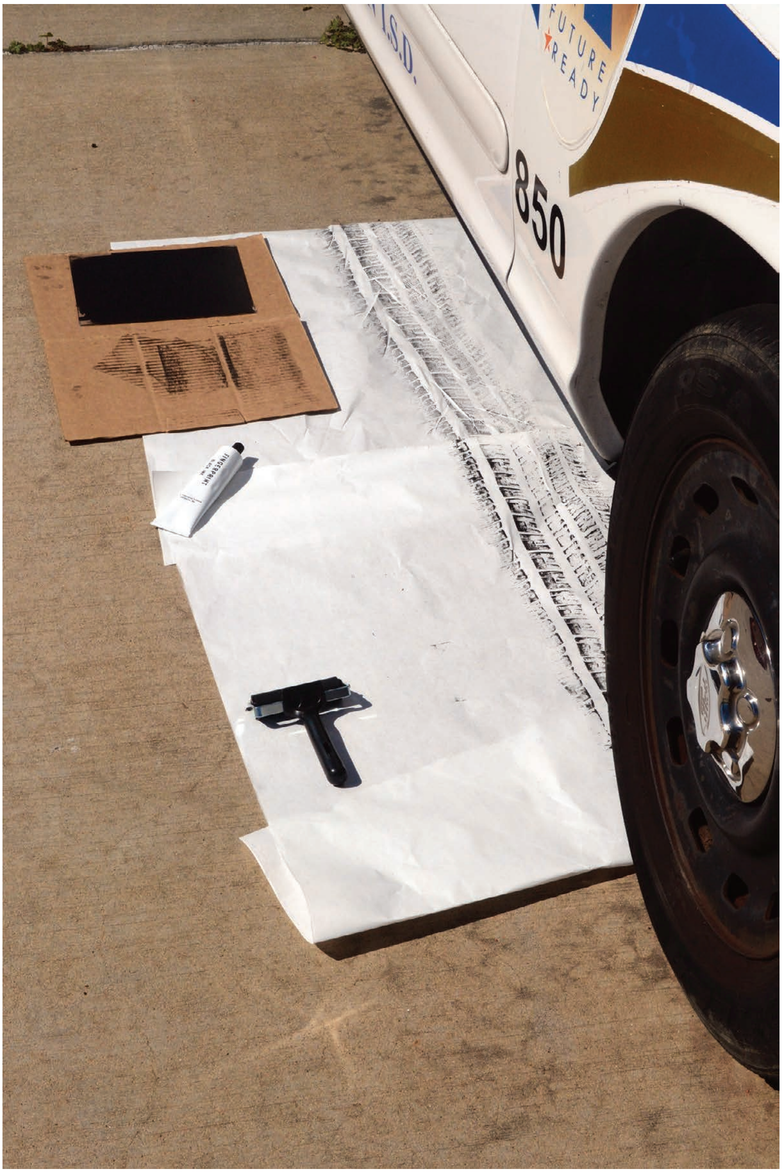


Figure 8.30 (Continued) (b) The resulting impression of the tire can be used to match with an impression recovered from a crime scene.

Conclusion

Two tasks are a consistent request for all evidence technicians when processing a motor vehicle and those are for the collection of DNA and latent fingerprint evidence. Although DNA evidence is the "hot" type of evidence that everyone wants to see in their cases, even after a hundred years, fingerprint evidence still possesses tremendous value in identifying those involved in criminal investigations. As a means to recover all the potential latent print evidence, fingerprint processors need to be methodical and diligent in their work. Leaving evidence behind because a particular fingerprint was on an "unprintable surface" or because it would take too much time to recover are not acceptable philosophies. If a fingerprint process is unsuccessful, then that is acceptable, but not trying to recover a latent print should not be acceptable. Remember that the end result of everything an investigator does during the processing of a vehicle or a crime scene will potentially come to light in the courtroom. This is a terrible place to try and think of an excuse for not doing everything possible to find all the evidence.

Fingerprint processors should develop a consistent or routine manner in which they process vehicles and the evidence contained within so that they do not miss or forget anything. Maintaining a consistent methodology for latent print development will also help with determining techniques that work best for the examiner. For example, the investigator will develop a preference for their favorite powder, brush, and tape combinations to use when processing latent prints. Evidence processors will also find a sequence of processing steps that suits their individual styles best. Processors do have to remain flexible, but with experience, fingerprint processing will become more efficient and productive. Just like writing thorough reports, investigators must complete their latent fingerprint lifts by ensuring the latent print lift cards are fully documented, including the case information, vehicle information, lift location, and ensuring the orientation of the print to the surface is noted. Experience is a great teacher and new investigators should practice and find what works for them. As an investigator becomes more proficient their overall work product becomes better as well.

Additional Readings

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Review Questions: Fingerprint and Impression Evidence Involving Motor Vehicles

1. Known fingerprint exemplars are typically displayed as ____________________ .
    a. White fingerprints on a black card
    b. Black fingerprints on a white card
    c. Gray fingerprints on a white card
    d. Gray fingerprints on a black card
2. What kind of light can an investigator use to visualize fingerprints developed with black powder on a dark painted surface?
    a. Ultraviolet light
    b. Direct lighting
    c. Oblique lighting
    d. Alternate light sources (ALSs)

3. What makes magnetic fingerprint powder a challenge to use when processing motor vehicles?
   a. Magnetic powder cannot be used easily on large surfaces
   b. Volcanic powder should always be used when available
   c. Magnetic powder does not work on fiberglass surfaces
   d. Motor vehicles have too many metal surfaces
4. Which of the following is NOT one of the typical fingerprint brushes found in an investigator's latent print kit?
   a. Cotton-thread fiber
   b. Camel hair
   c. Fiberglass
   d. Magnetic wand
5. "Latent Fingerprints" means the fingerprints are ____________.
   a. Developable
   b. Discoverable
   c. Hidden
   d. Secure
6. The two biggest errors committed while fingerprint processing are ____________ and too much powder.
   a. Too much pressure
   b. Too little experience
   c. The wrong fingerprint brush
   d. Incorrect brushstroke
7. Which of the following best describes how a fiberglass brush should be used on a surface being powder processed for latent fingerprints?
   a. Just hard enough that the bristles flex outward about 45°
   b. The bristles do not actually touch the surface, because the powder simply falls onto the surface
   c. The brush is firmly dragged back and forth across the surface
   d. The tips or ends of the brush are lightly spun across the surface
8. In less serious crimes, such as a simple car theft, evidence technicians should concentrate on the vehicle's interior and disregard processing the vehicle's exterior because it is not against the law to touch someone else's car or truck.
   a. True
   b. False
9. How close to the latent print should fingerprint tape be applied?
   a. The tape should be placed directly on top of the print and smoothed outward
   b. The tape should be placed immediately next to the print to save resources
   c. The tape should be placed within a ½" of the print
   d. The tape should be placed at least a ½" to 1" away from the print
10. Which type of fingerprint tape changes in appearance to let a fingerprint processor know when the tape has adhered properly to the printed surface?
    a. Gel lifters
    b. Frosted fingerprint tape
    c. Clear fingerprint tape
    d. Packaging tape

11. Which type of fingerprint creates the most difficulty because it is susceptible to the creation of air bubbles and creases?
    a. Gel lifters
    b. Clear fingerprint tape
    c. 1"-wide tape
    d. 4"-wide tape
12. What is an important and necessary step to complete the adherence of tape to a powdered latent print?
    a. "Dog-ear" the tape that remains on the roll of tape
    b. Use a pocketknife to trim the excess lift card around the fingerprint tape
    c. Place the investigator's initials on the tape placed over the developed print
    d. All of the above
13. Where is the best place to document a fingerprint's orientation to the surface it was recovered on?
    a. Offense report
    b. On the lifted fingerprint itself
    c. On the back of the fingerprint lift card with all the other case information
    d. On the side of the fingerprint lift card possessing the lifted latent print
14. When should visible fingerprints, such as bloodstained fingerprints, be photographed?
    a. Before any lifting attempt
    b. During any lifting attempt
    c. After any lifting attempt
    d. Photography is not required
15. What technique might work well when processing latent fingerprints on textured surfaces?
    a. Diff-Lift or gel-type fingerprint tape
    b. Elmer's Blue Gel Glue lifting technique
    c. AccuTrans silicone lifting kit
    d. All of the above
16. What is the preferred humidity level when using cyanoacrylate fuming to develop latent fingerprints?
    a. 40–50%
    b. 60–70%
    c. 70–80%
    d. 80–90%
17. At what temperature (Fahrenheit) can cyanoacrylate turn into poisonous hydrogen cyanide gas?
    a. 32°
    b. 150°
    c. 212°
    d. 220°
18. What is the formula to determine the circumference of a tire?
    a. $2\pi r^2$
    b. πd
    c. πr^2
    d. πr

19. What can be added underneath the butcher paper to roll a tire's inked impression across a slightly bumpy floor?
    a. It cannot be done. The examiner needs to find a smooth surface to roll the tire across
    b. Flattened cardboard
    c. Porcelain tiles bought at any home improvement store
    d. Particle board
20. What can be used to speed up the drying time of Elmer's Blue Gel Glue
    a. Hair dryer
    b. Humidity
    c. Fuming chamber
    d. A small fan

Processing Vehicles Involved in Shootings

9

According to the Federal Bureau of Investigation's (FBI) Uniform Crime Report (UCR) for 2018, there were 14,123 homicides in the United States. Of those deaths, 10,265 were committed with some type of firearm. That is, just over 72% of all homicides were committed by some sort of firearm. According to the UCR, the firearms used in the commission of the offense were broken down as follows:

- *Handguns*—6603 deaths
- *Rifles*—297 deaths
- *Shotguns*—235 deaths
- *Unknown or unreported type of firearm*—3130 deaths

As seen in these numbers, the chances are good that a crime scene investigator is going to find themselves examining a vehicle involved in a shooting. This is especially true in more urban communities, where it is almost a daily occurrence. Remember, these numbers are only reporting homicides. It does not include the 185,437 aggravated assaults committed by firearms in 2018. It should go without saying that if a vehicle is involved in a shooting incident, then the investigators must complete a thorough examination of the vehicle in the hopes they can help identify the perpetrator. This chapter is geared toward the documentation and collection of ballistic evidence. Numerous textbooks cover the more advanced techniques of crime scene reconstruction. However, reconstruction cannot be completed without a well-documented crime scene or vehicle examination.

The examination of a vehicle involved in a shooting all begins with competent documentation of the vehicle. Before a discussion on the documentation of a vehicle occurs, investigators should have knowledge of the language or the nomenclatures of firearms and ammunition. Everything begins with the firearm itself. There are all kinds of weapons on the market and even firearms examiners will be challenged by a unique gun from time to time. However, weapons commonly found at crime scenes fall into seven broad categories:

- Revolver handgun
- Semi-automatic handgun
- Pump-action long gun
- Lever-action long gun
- Bolt-action long gun
- Semi-automatic long gun
- Break-open action shotguns

By no means is this list a comprehensive list of firearms but they are the most commonly found firearms at a crime scene. An investigator may find themselves with a fully automatic pistol or some antique revolving rifle. However, with a basic understanding of weapon

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functionality, investigators will be able to give the weapon an accurate classification by providing an accurate description of the firearm.

Revolvers are classified as such because the ammunition is contained within a revolving cylinder, thus the name “revolver” (Figure 9.1). When a revolver’s trigger is pulled, the cylinder rotates and then the hammer falls, striking the cartridge’s primer, setting off the ignition train and propelling the projectile down the barrel. The weapon can be repeatedly fired as many times as there are live cartridges loaded into the cylinder. If the trigger is not pulled again, the fired cartridge case will rest underneath the hammer and firing pin. This is an important point to remember in the cases of suicides and a revolver is used. The documentation of the cylinder will be explained in the section “Processing and Examination of Recovered Firearms.” A revolver will fire one cartridge for one pull of the trigger.

“Semi-automatic pistols” are firearms that store their ammunition in an ammunition magazine (Figure 9.2). Semi-automatic pistols are generally capable of carrying more rounds than a revolver. The magazine has a spring in its base that presses the ammunition upward. With the magazine inserted into the weapon and when the trigger is pulled, the hammer strikes the cartridge’s primer, which propels the projectile down the barrel of the weapon. Unlike the revolver, the top slide of the firearm moves to the rear of the weapon and ejects the fired or spent cartridge case out of the weapon. As the top slide returns forward, it picks up the next live cartridge in the magazine and places it into battery. The weapon can be immediately fired again with a pull of the trigger. Some semi-automatic weapons can be fired without the magazine inserted into the weapon, as long as there is a live cartridge chambered in the pistol. Some semi-automatic handguns have an additional safety, that

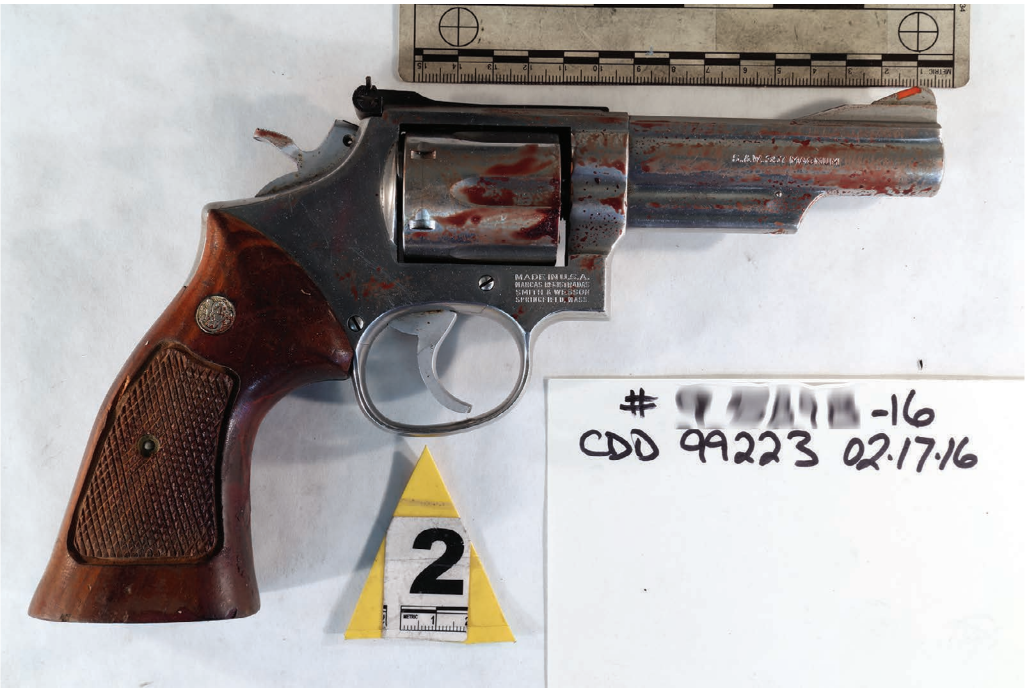


Figure 9.1 A revolver is a firearm that stores its ammunition in a cylinder and every time the trigger is pulled, the cylinder rotates, then the hammer falls onto the primer, which starts the ignition train, resulting in the propulsion of the projectile down the weapon’s barrel.

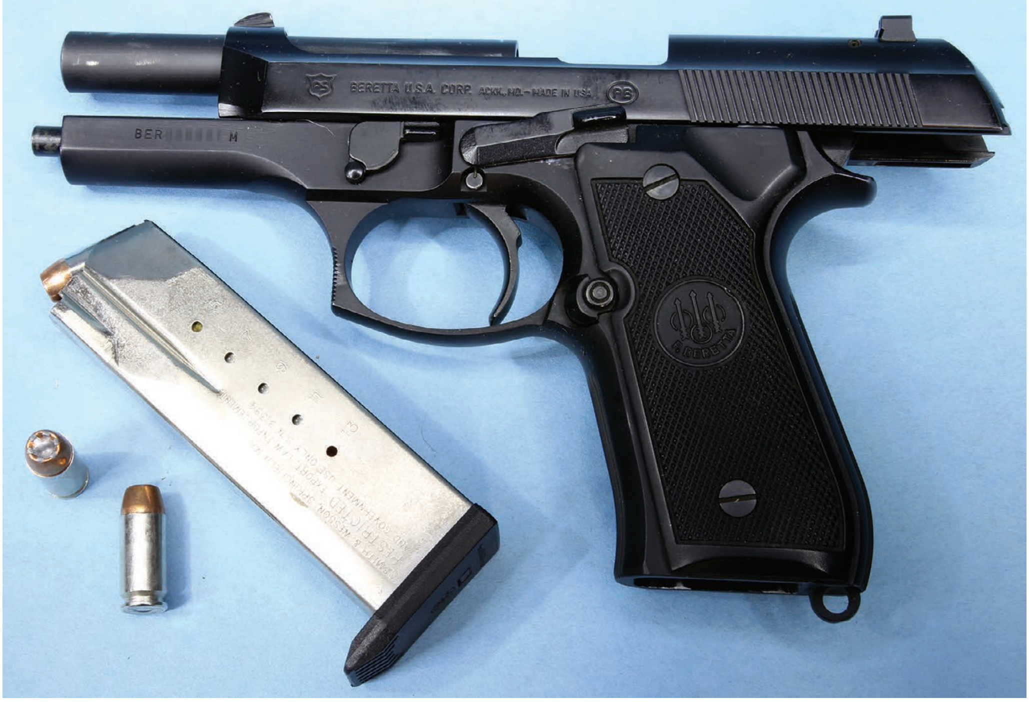


Figure 9.2 A semi-automatic pistol will fire one round for every one trigger pull. Ammunition is stored in a magazine and in the natural process of firing the weapon, the spent cartridge cases are ejected from the weapon and a live cartridge is picked up from the magazine and placed into the battery for the next pull of the trigger.

prevents the firearm from being fired if a magazine is not inserted into the weapon. In addition, some pistols have been modified to fire full-automatic, but those are less commonly found on the scene of a crime. However, investigators should be aware of their existence. The fired cartridge cases are extremely valuable pieces of evidence and should be recovered from inside vehicles or at crime scenes. The fired cartridge case's primer possesses the firing weapon's fingerprint and can link the weapon to the fired cartridge case.

Long guns or long-barrel firearms are more commonly referred to as rifles and shotguns. These firearms generally have a barrel length greater than 18". First in the broad categories of long guns are "pump-action" long guns (Figure 9.3). Pump-action long guns possess a grip mounted below the barrel that when pulled backward will eject a spent shell or cartridge out the ejection port and at the same time, pull a live cartridge or shell from the magazine tube. When the forearm (grip) is pushed forward, it will push the cartridge or shell into battery. The magazine tube will hold the live cartridges or shells and is mounted below the barrel. Pump-action firearms will fire one round per trigger pull and the forearm or grip must be actuated between fired shots.

"Lever-action" long guns are similar to the pump-action long guns, in that they will possess a magazine tube mounted below the barrel, and the tube stores the live cartridges or shells (Figure 9.4). Instead of the pull–push action found on a pump-action long gun, the lever-action that ejects the fired cartridges from the weapon and places the live cartridge into battery is a hand-activated lever, generally mounted below the trigger. Lever-action long guns will fire one round per trigger pull and the lever-action must be actuated between fired shots.

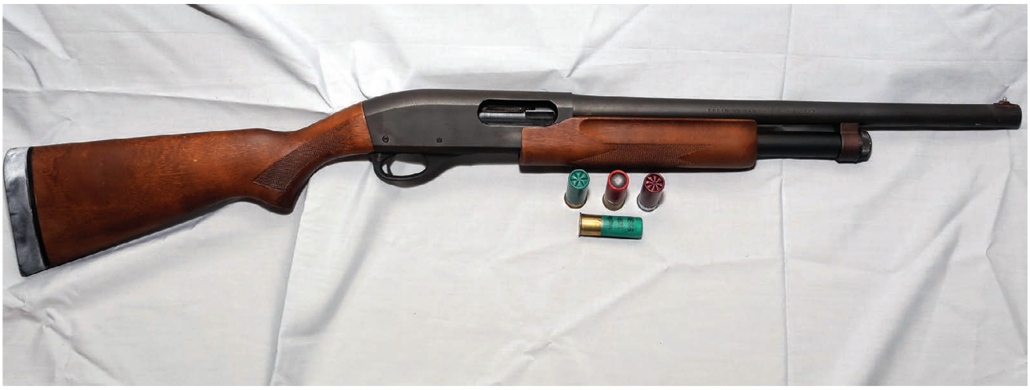


Figure 9.3 A pump-action long gun has a cocking and loading mechanism that is pulled back toward the shooter and pushed forward to complete the chambering process. Long guns typically have a barrel length greater than 18".

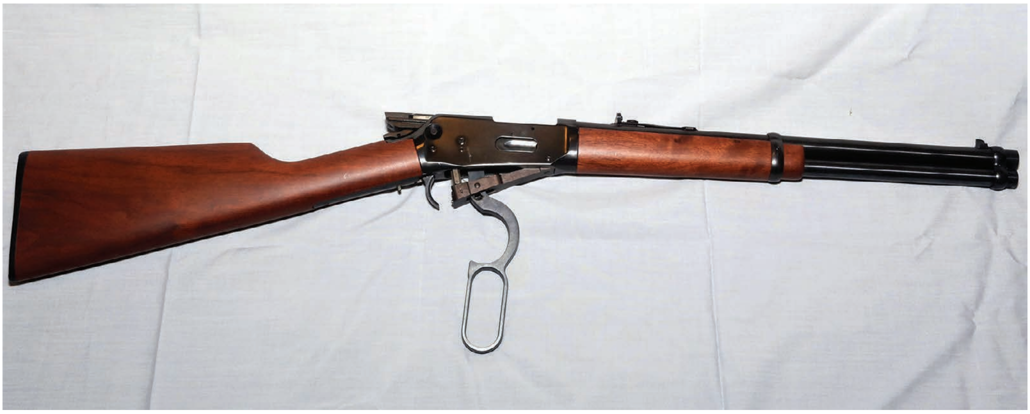


Figure 9.4 A lever-action long gun has a pivoting handle that ejects the fired cartridge case from the breach and moves the live cartridge from the magazine tube into the chamber. Once chambered, the weapon will fire one round per trigger pull.

"Bolt-action" long guns are not commonly found at crime scenes. In fact, in the over 10,000 homicides where a firearm was used in 2018, only 297 rifles and 235 shotguns were used and that includes all types of rifles, including semi-automatic rifles and all types of shotguns. Bolt-action long guns have a "bolt handle" that connects directly with the receiver or ejection port and is manually rotated and pulled back by the shooter and then pushed forward to return the bolt to its firing position (Figure 9.5). The manual operation of the bolt opens the ejection port, ejects the fired cartridge case, and places a live cartridge into battery. Cartridges are generally loaded into the weapon via an ammunition magazine, clip, or tube. As before, the bolt-action must be actuated between each fired shot.

Handguns by far exceed the use of rifles in the perpetrating of violent crimes. However, the most common long gun used in homicides is the semi-automatic rifle. Investigators should be aware that semi-automatic rifles are not the only semi-automatic long guns. There are semi-automatic shotguns that are prevalent on the market. Semi-automatic means that with every pull of the trigger, only one round is discharged. Full-automatic

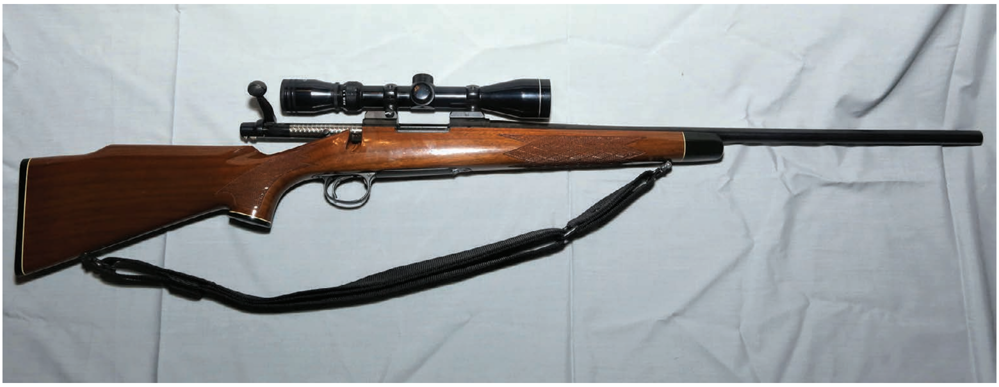


Figure 9.5 A bolt-action long gun is manually operated by the bolt handle, which is mounted to the receiver, and the bolt handle is pulled to the rear of the rifle to eject the fired cartridge or shell and is then pushed forward to chamber the next round into battery.

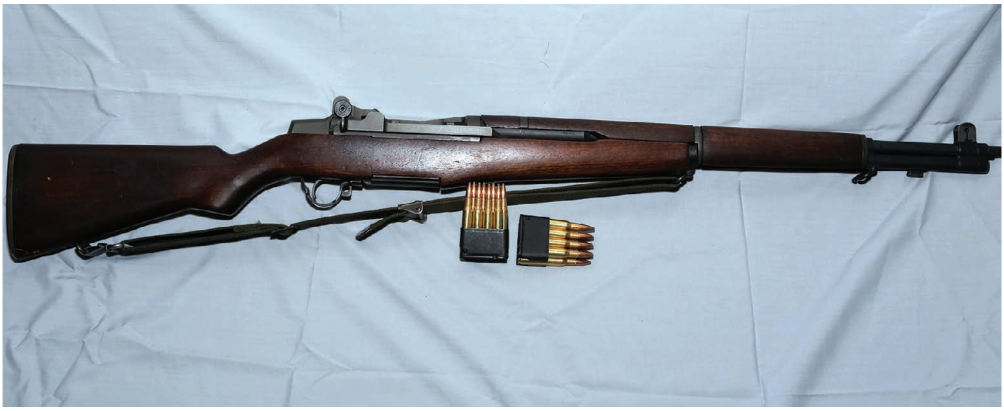


Figure 9.6 Semi-automatic long guns will "automatically" load the next cartridge into battery via the gas pressure produced by the cartridge's discharge. The weapon will fire one round per trigger pull. Rifles and shotguns will store their ammunition in an ammunition tube, magazine, or in the case of this M-1 Garand, the ammunition is stored in a clip. Full-automatic weapons will fire multiple rounds on a single pull of the trigger.

weapons will continue to fire rounds down range as long as the trigger remains depressed. The determination of semi-automatic versus full-automatic weapons may not be determined by crime scene investigators, but rather by firearms examiners, because semi-automatic weapons can be modified internally to shoot in full-auto mode even though that was not how they were originally designed. Semi-automatic rifle cartridges and shotgun shells are generally loaded into a magazine or clip for storage in the weapon. However, there are those weapons with large capacity drum-style magazines that increase the number of rounds fired between reloadings. The semi-automatic long guns work similar to their pistol counterparts. The trigger is depressed and the gas from the fired cartridge forces the receiver back, which ejects the fired cartridge case, and then the receiver returns forward, picking up a live cartridge on the way back and places it into battery. This cycle can continue for as long as live cartridges remain in the magazine or clip.

A "break-open" action long gun operated weapon is typically found in the shotgun family of weapons (Figure 9.7). There are some break-open revolver pistols on the market,

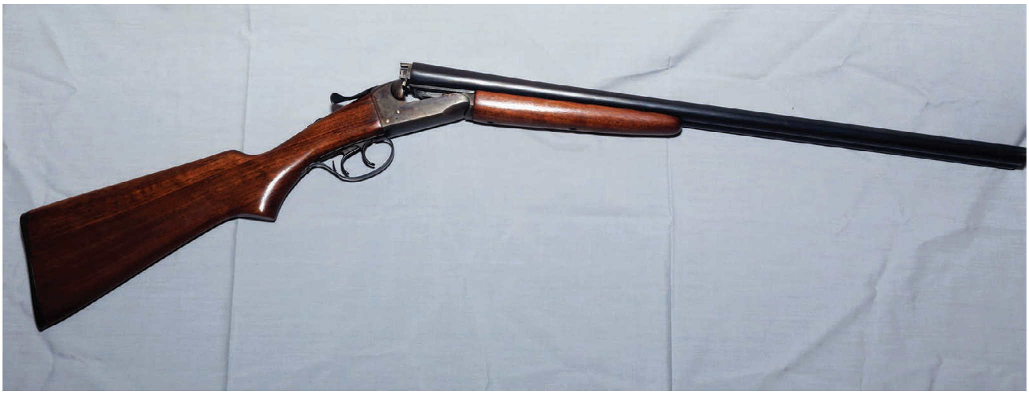


Figure 9.7 A break-open action weapon operates by separating the weapon at the end of the barrel or chamber that is hinged together below that point. Fired shotshells are removed by hand and live ammunition is loaded by hand in these styles of weapons.

but again, these are not that commonly found on a crime scene. Break-open style revolvers are just something to be aware of in case one is encountered during an investigation. The weapon "breaks" open at the receiver to expose the chamber or the rear of the barrel(s). The shotshells are placed individually and by hand into the chamber at the rear of the barrel or into a revolver's cylinder. If there are fired shotshells in the weapon, they too are removed by hand. The break-open action is closed and the weapon is fired by depressing the trigger.

Understandably, these categories are not all-inclusive. Firearms collecting and sport shooting are extremely popular hobbies in the United States. As a result, weapons come in all styles and varieties. In addition, weapons can be modified to conceal their potential, like turning a semi-automatic rifle into a full-automatic rifle. Consequently, crime scene investigators cannot be expected to recognize and have a thorough knowledge of every type of firearms, because they are not likely to be full-fledged firearms examiners. However, they should be familiar with the nomenclature of weapons and the basic functionality of weapons. Understanding how to unload or clear a firearm is important for the safety of the investigator and those working nearby. Any accidental discharges can have grave consequences. Additionally, an evidence technician should be able to speak confidently in front of a jury about the weapon's operation. Investigators will routinely be called upon to testify about their investigation and in the case of shootings, the prosecutor must prove the "elements of the offense" to the jury. One of the standard "elements" listed in penal codes around the country for crimes like aggravated assaults, robberies, and homicides is that a weapon is capable of causing "serious bodily injury or death." This is where the criminal investigator should be able to articulate how a recovered weapon operates and should be able to answer the question as to whether or not the weapon is capable of causing serious bodily injury or death. If an investigator is not confident in their ability to articulate a unique weapon's functioning or capability, then they should inform the prosecutor of that fact so that they may subpoena a firearms examiner to address those issues. Any success at trial is a team effort between evidence technicians, criminal investigators, and a host of laboratory personnel. One individual does not have to do it all.

All firearms need one common addition to turn them into a deadly weapon and this is live ammunition. The number and types of ammunition available to the average consumer are nearly endless. Just like firearms, entire textbooks have been written on the types of ammunition, the capabilities, composition, and characteristics. Crime scene investigators are tasked with the documentation and recovery of ballistic evidence, not necessarily do they have to be firearms examiners. The goal of the evidence technicians should be to locate all the evidence and recover it in as pristine a condition as possible. So that evidence technicians, criminal investigators, firearms examiners, and/or shooting reconstructionists can communicate with each other and share information, they must be talking in the same language. Therefore, identifying the evidence correctly and using the proper terminology in reports is important so that informative communication can take place between scene investigators and laboratory personnel.

The first question to ask is what kind of descriptive terms are used for ammunition? Live pistol and rifle ammunition are referred to as a "cartridge" (Figure 9.8). A cartridge is live ammunition that has not been fired. A cartridge contains a cartridge case that has a primer in its base and holds the gunpowder that will propel the "bullet" or "projectile" down the barrel. When the trigger is pulled on a firearm, the weapon's internal firing pin will strike

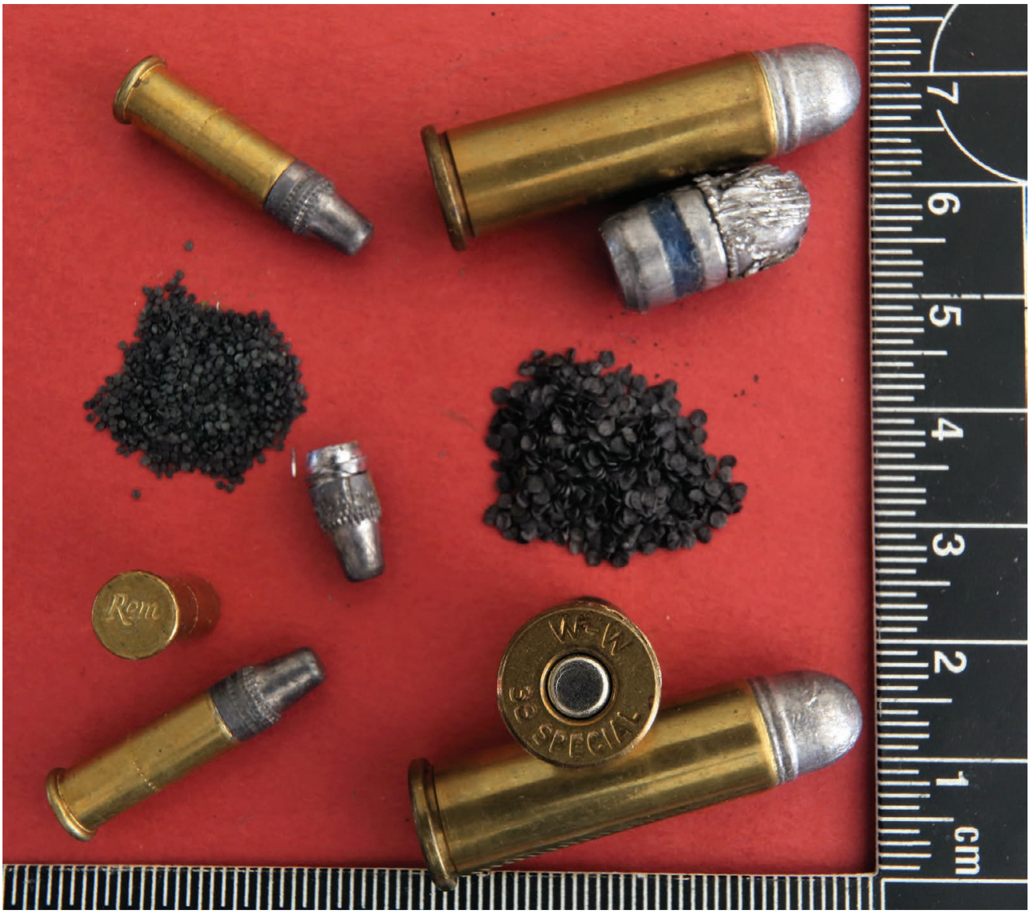


Figure 9.8 A live cartridge consists of an ammunition cartridge case, which possesses a primer (rimfire or centerfire), gunpowder, and a bullet or projectile. This image shows the individual parts of a .22 caliber rimfire cartridge and a .38 caliber centerfire cartridge.

the primer causing a small explosion. The small explosion causes the gunpowder to burn, building up gas and pressure. The expansion of gas and pressure propels the bullet down the firearm's barrel and down range toward the target. Investigators will likely encounter two broad categories of cartridges that involve the type of primer the ammunition uses. The two commonly found primer types are rimfire and centerfire primers. By far, the most commonly encountered cartridges are the centerfire cartridges. Regarding the correct terminology, when the weapon has been fired, the investigator should identify the projectile as a "fired bullet" and the cartridge as a "fired cartridge case." Some investigators will interchange the word casing for fired cartridge case, but the more definitive or clear term is fired cartridge case. The base of a cartridge case will have some style of manufacturer's name or trademark. On larger caliber ammunition that has more space for lettering, the headstamp will likely contain the manufacturer's name as well as the caliber information (Figure 9.9). Investigators should record and document these manufacturer marks and identifying information on all ammunition recovered from a vehicle. Investigators should be aware that some manufacturers and shooting enthusiasts produce "reloaded" ammunition. Reloaded ammunition occurs when fired cartridge cases have their primers replaced and are reloaded with powder and a projectile, so that the cartridge can be discharged again. Using the proper terminology helps avoid confusion. When someone says the word "bullet," it begs the question does the person mean an unfired projectile, which technically is more correct, or do they mean the entire live cartridge? By keeping terminology specific, clear, and uniform, investigators can better relay their findings to other investigators, laboratory personnel, and during any potential testimony.

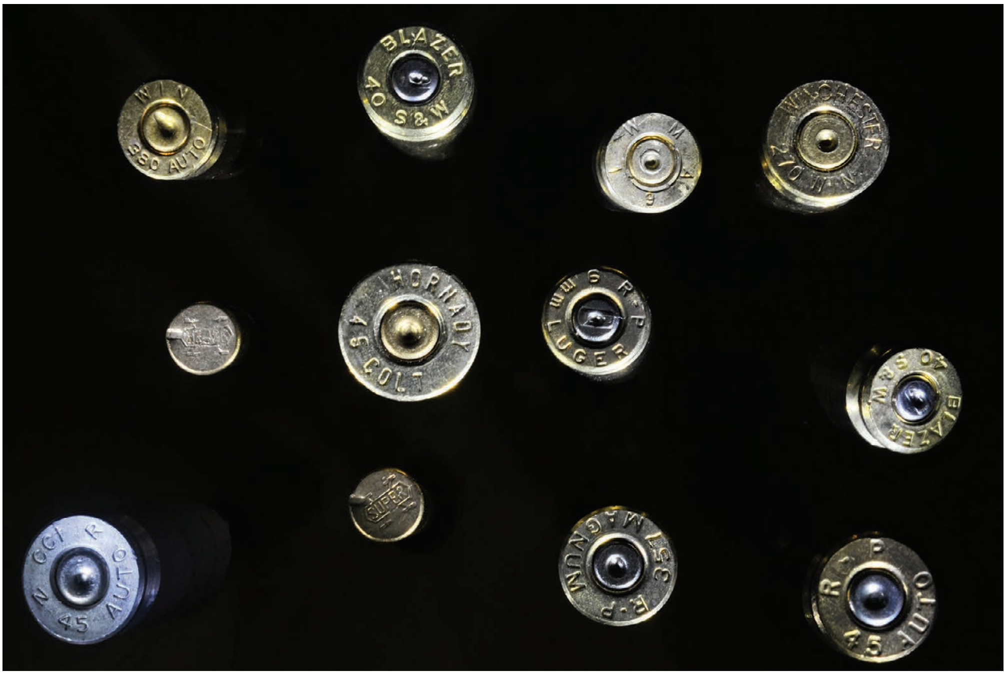


Figure 9.9 The base of the cartridge case will have some type of manufacturer's mark and/or the identification of the ammunition's caliber. Ammunition is manufactured by numerous companies. Investigators should also be aware that on rare occasions, some ammunition might have been reloaded and a cartridge's components might not be consistent with the manufacturer's original cartridge.

Ammunition comes in a variety of sizes, better known as calibers. Caliber actually refers to the internal diameter of a firearm's barrel or bore, but without a micrometer to tell the difference, the bullet will appear to have the same diameter as a weapon's bore of the same caliber. The bullet needs to be firmly seated within the barrel so that the gas pressure built up by the cartridge's firing will push the bullet down the barrel, instead of allowing the produced gas to escape around the bullet and exit harmlessly at the end of the barrel. Like everything else in the world of ballistics, caliber types are wide and varied. The easiest to identify are the cartridges marked with "mm" or millimeter, like 9, 10, and 40 mm. These markings are located on the base of the cartridge case, often referred to as the "headstamp" markings. The diameter of these bullets is the widths matching the identifying number on the cartridge case. Other ammunition use inch measurements and more specifically, hundredths of an inch measurement, like the following common diameters of ammunition marked as calibers .22, .25, .32, .38, .40, .45, and .50. Some ammunition is measured in thousandths of an inch, such as .223, .357, .380 caliber ammunition.

Shotguns are loaded with shotshells. Shotguns also come in different sizes, which are referred to as gauges. The most common gauges are 12 and 20 gauge, but there are 10, 16, and 28-gauge shotguns. The smaller the gauge number, the greater the shotgun-barrel's diameter. For example, 12-gauge shotguns have a larger bore diameter than 20-gauge shotguns. The gauge does not directly refer to the size of the weapon's bore because it actually refers to the weight of the lead that can fit inside a shotgun's barrel. A .410 shotgun is the exception to the rule. A .410 shotgun has a bore diameter of 41-hundredths of an inch wide.

Shotshells pose a particular challenge to investigators, because they have such a variety of compositions (Figure 9.10). Shotshells are classified by a shot number, ranging from 1 to 12. Number 1 shotshells have fewer pellets per load, because each pellet measures approximately .17" in diameter. Number 12 shotshells have a greater number of pellets per load and measure approximately .05" in diameter. Manufacturers will offer for sale a choice in how many pellets per load, but generally the overall weight equals one ounce of shot. One ounce of shotshell projectiles is standard. However, many manufacturers will make shells with slightly more and slightly less total weight of shot or pellets. As a reference, one ounce of Number 9 12-gauge shot possesses approximately 585 individual projectiles, while Number 2 12-gauge shot has approximately 90 individual projectiles. These numbers are simply for reference because shotshells do come in different compositions and overall weights. Standard shotshells measure 2.75" in length but can go all the way up to 4" in length. Shotshells having smaller, but more numerous pellets are generally referred to as "birdshot." "Buckshot" rounds are generally identified as 000, 00, 1, 2, 3, and 4 and have larger-sized pellets. 000 buckshot is the largest diameter pellets, measuring approximately .36" in diameter. In contrast, number 4 buckshot measures approximately .24" in diameter, while #4 birdshot pellets measure .13" in diameter. The number of pellets varies just as much, but in general, the larger the shot, the fewer the number of individual pellets and vice versa. As an example, one ounce of #2 birdshot will have about 124 pellets, while one ounce of #7 shot will have approximately 420 pellets. And to complicate a vehicle examiner's life even more, shotgun ammunition also comes in single projectile or "slug" rounds. Overall, shotshells offer unique challenges to investigators because they may not know how many shotshells were fired at a vehicle, what kind of shotshells were utilized, and/or how many individual pellets were originally a part of the fired shotshell. As a result, whenever a shotgun is fired into a vehicle, especially with birdshot, investigators must take great pains to locate as many of the pellets as they possibly can and this can become quite an ordeal.

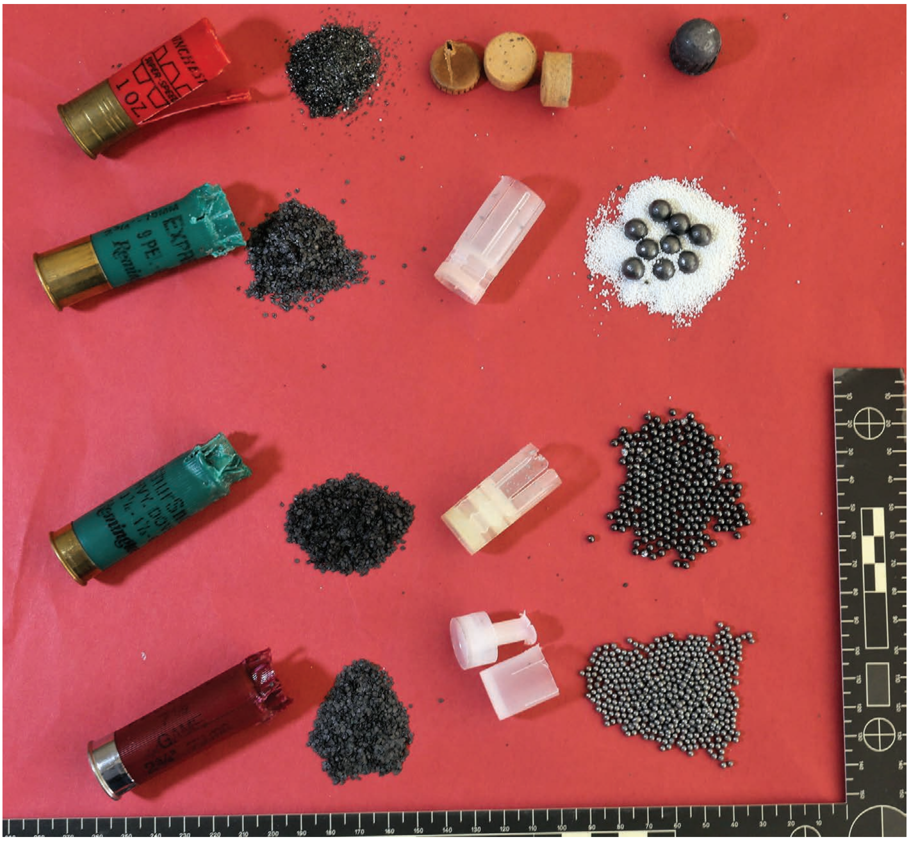


Figure 9.10 These four 12-gauge shotshells have been disassembled. Each shotshell contains one ounce of projectiles, from top to bottom: Winchester Slug Round, Remington "00" (9-Pellet) Buckshot, Remington #6 Heavy Dove Shot, and Federal 7–1/2 Game Shot.

Processing and Examination of Recovered Firearms

Once a firearm is recovered, the common, but erroneous, thought is to immediately make the gun "safe." However, a firearm will not discharge unless one pulls the trigger. There should not be a rush to strip the gun of all kinds of potential information and evidence just to make the gun safe immediately. Of course, the weapon needs to be physically touched to be recovered and that should be done with a fresh pair of gloved hands. The recovery of the weapon should be with a minimal amount of touching to prevent the destruction of potential DNA and fingerprint evidence. Unlike one sees on television, investigators should never slide anything into the barrel of the firearm in order to pick it up. Placing something into the barrel of the firearm can possibly change the rifling characteristics that are imparted onto the fired bullet and thereby affect the ability of the firearms examiner from making a match between the weapon and the fired projectile. And while the subject has been broached, another major error seen in television crime dramas is that weapons and other pieces of evidence are collected and examined before being photographically documented in its original position. Always make sure that all evidence is fully photographed and documented before its recovery.

Prior to picking up the firearm, the investigator should prepare a clean area to place the recovered weapon, such as a table and it would be best to have a clean piece of butcher paper rolled out over the table. Once the weapon has been removed from a vehicle, it can be placed on this clean surface and visually examined. The investigator is not yet trying to identify the weapon, but simply view its overall condition and appearance. For example, if the gun has a safety, the position of that safety (on or off) is extremely important to know before the gun is cycled in order to clear the weapon. If there is a question as to who fired the weapon or who may have handled it, then the weapon should also be examined with oblique lighting and look for any potential fingerprints on the weapon. Eventually, the weapon will be processed for DNA and fingerprints and if a fingerprint is visible in the oblique light, that surface should get priority for processing and carefully avoided when clearing the gun before such processing.

At this point, the weapon may be carefully cleared. Beginning with revolvers, before the cylinder is opened, a Sharpie type permanent marker should be used to make a mark on either side of the top strap (Figure 9.11). The purpose of making the two marks is to make it clear which chamber was underneath the hammer once the cylinder is pulled away from the gun's frame. Next, the cylinder's rotation direction should be documented, along with how each of the cylinder's chambers are loaded. The cylinder's rotation direction can be determined by looking at the small depressions behind the cylinder flutes. These marks typically are rectangular at the top and have a small round or oval teardrop depression below the rectangular notch that stops the cylinder in the proper firing position. The rounded teardrop portion of the depression points in the direction of rotation (Figure 9.12). Evidence technicians should also record how the cylinder is chambered. Drawing a simple picture or drawing of the cylinder in one's handwritten notes is the easiest way to notate the headstamp markings or identifiers and whether the cartridge was live, fired, or the chamber was empty.

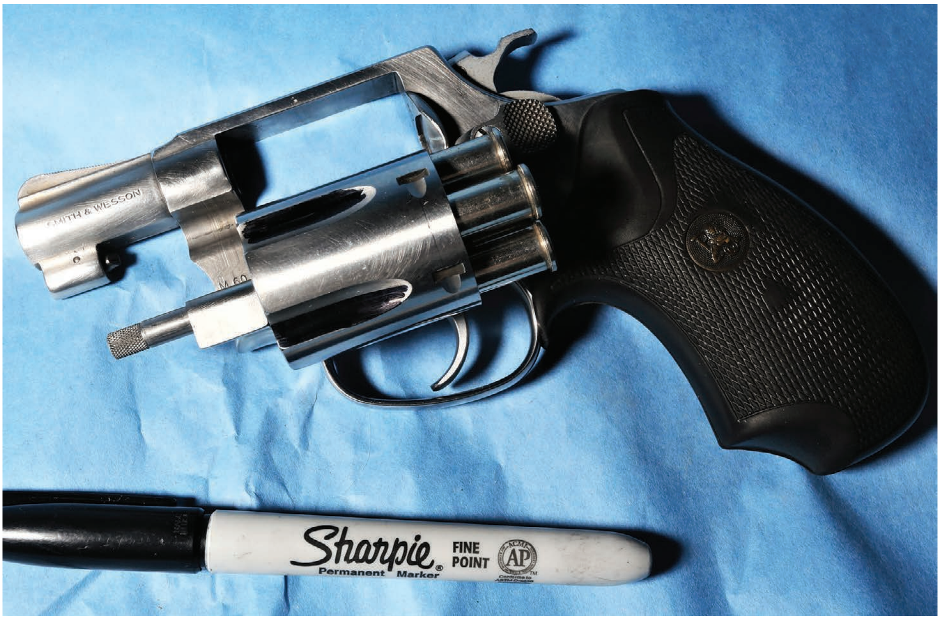


Figure 9.11 By placing a mark on each side of the weapon's top strap, the investigator can positively identify the cylinder's chamber that was underneath the hammer and firing pin after the cylinder is released from the weapon's frame.

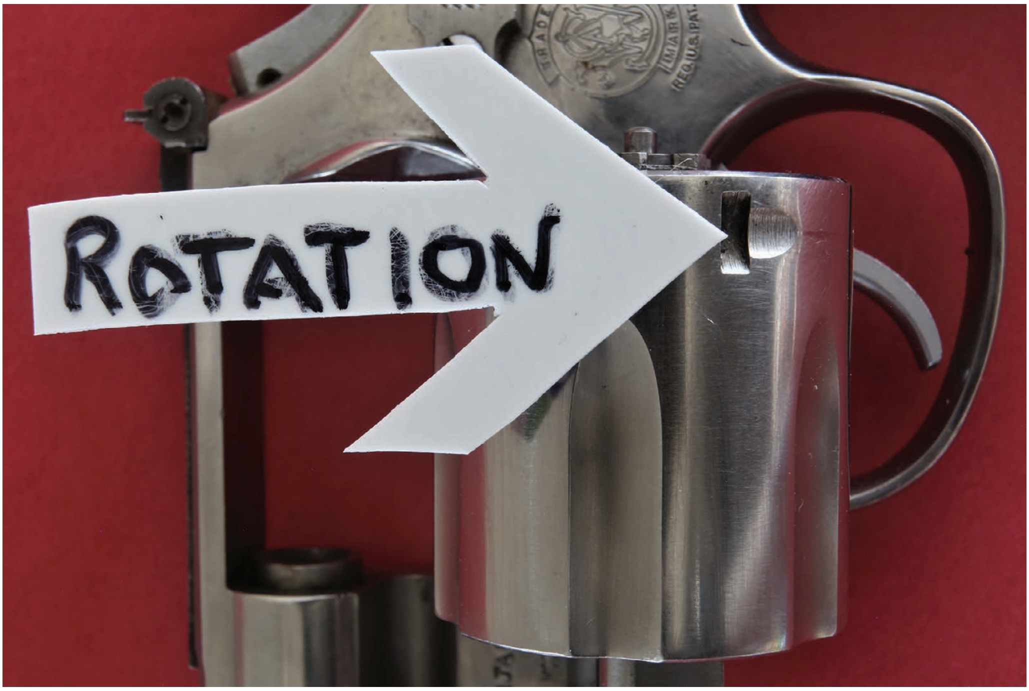


Figure 9.12 Once a revolver is rendered safe, investigators must also make notations about the cylinder's direction of rotation and how each chamber was loaded. The cylinder's rotation direction can be noted by the small notch on the side of the cylinder. The small rounded or teardrop depression points in the direction of the cylinder's rotation.

When semi-automatic handguns or any of the long guns are cleared of ammunition, the magazine or clip should be removed from the weapon and set temporarily to the side on clean butcher paper. It should go without saying, but always treat every firearm as if they are always loaded. Next, the chamber should be cleared and checked for any remaining ammunition. The live cartridge removed from the chamber should be set to the side, but do not put it back into the ammunition magazine or clip, if so equipped. If the long gun has a magazine tube, this should also be cleared of any remaining ammunition. The ammunition should be extracted one cartridge or shotshell at a time and lined up in the order that they were removed from the weapon. How the ammunition was lined up or stacked in the magazines, clips, or tubes will be documented in the investigator's written notes. This kind of specificity is not needed in all investigations, but one may not know of the importance of any chambering order at the time of recovery. Therefore, complete documentation is necessary. Furthermore, defense attorneys may ask an investigator the chambering order of a weapon for no other reason to show that the investigator was unprepared or not thorough enough in their investigation.

Before extracting all the live cartridges out of an ammunition magazine or handling the ammunition and weapon any further, investigators need to process the items for latent prints and DNA evidence. Specifically, the magazine and ammunition inside of a weapon are a gold mine for DNA and latent fingerprint evidence. Suspects have been known to wipe down guns before discarding them, but they forget about all the ammunition inside the weapon. Beginning with the firearm itself, the investigator should have already visually examined it for potential fingerprint evidence. If something was observed, then that area should be processed for potential print evidence. When looking at the gun, textured areas are less likely to hold fingerprints of any value. Therefore, those are great places to start collecting DNA swabbing samples. DNA swabbing techniques were covered in Chapter 7. The following surfaces are general areas that are less likely to possess fingerprint evidence and the collection of DNA can be done without disturbing areas that potentially possess latent prints:

- Revolvers
  - Trigger
  - Grips
  - Cylinder release button
- Semi-automatic pistols
  - Trigger
  - Grips
  - Magazine release button
  - Safety selector switch
  - Back end of the top slide (This area is usually grooved for the shooter to grasp in order to pull back the slide to clear the weapon)
- Long guns
  - Trigger
  - Bolt or lever action, if so equipped
  - Butt plate and or grips, but not necessarily the stock. The stock can be fingerprinted if it is smooth and not heavily textured
  - Safety selector switch
  - Forward grip, if heavily textured

There are always exceptions to every rule and as such, all investigators need to look at the weapon they are processing for evidence and decide what is the most likely evidence recovered from a particular area on the firearm—DNA evidence or latent print evidence. There is one more location on firearms that potentially has an abundance of DNA and that is behind the grips. All pistols have grips and even some long guns will have hand grips. The grips are attached with a small set screw on one side of them (Figure 9.13). The grips can then be easily removed and DNA swabbing collections are made to the inside edge of them. The grips can eventually be replaced without causing any concerns with the firearms examiner's work or damage to the firearm.

If visible blood is present on the weapon or ammunition, then clearly that would be an area that should be swabbed for DNA as well. The blood should obviously be photographed before any swabbing takes place and when that blood is found inside the gun's barrel, special care should be made to capture a quality photograph of the blood. It is possible to photograph inside a gun's barrel by introducing a small light into the back end of the barrel. This process must be completed with the caveat that fingerprinting of the weapon has been completed, because the weapon will be handled quite extensively in setting up the photographic composition. A single-bulb LED light with a flexible head or a fiber optic flashlight attachment for a small penlight flashlight (available at tool supply stores) are outstanding devices to complete this type of evidentiary photograph (Figure 9.14). This technique was described in Chapter 5.

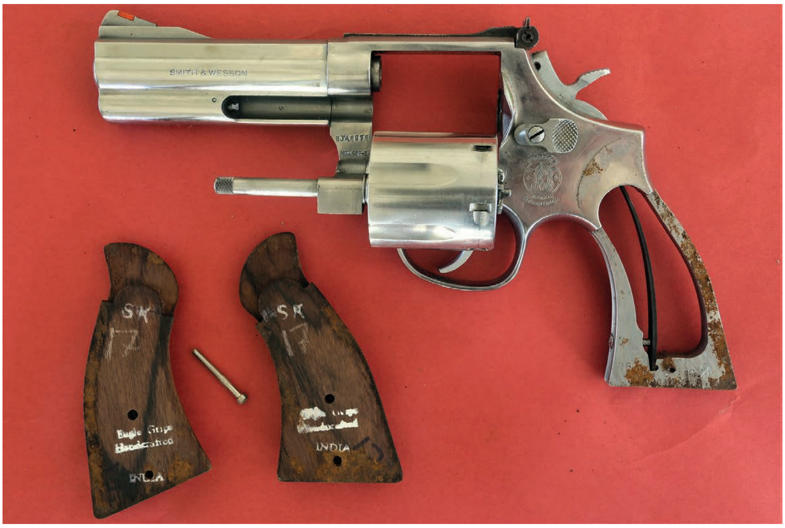


Figure 9.13 Besides the standard trigger, cylinder release button, and exterior portion of the grips, a great place to recover quality DNA samples from is behind the pistol's grips. Grips are typically held on by a single set screw and the grips will separate from the gun's frame. The interior surfaces of the frame and grips can be swabbed for DNA evidence.

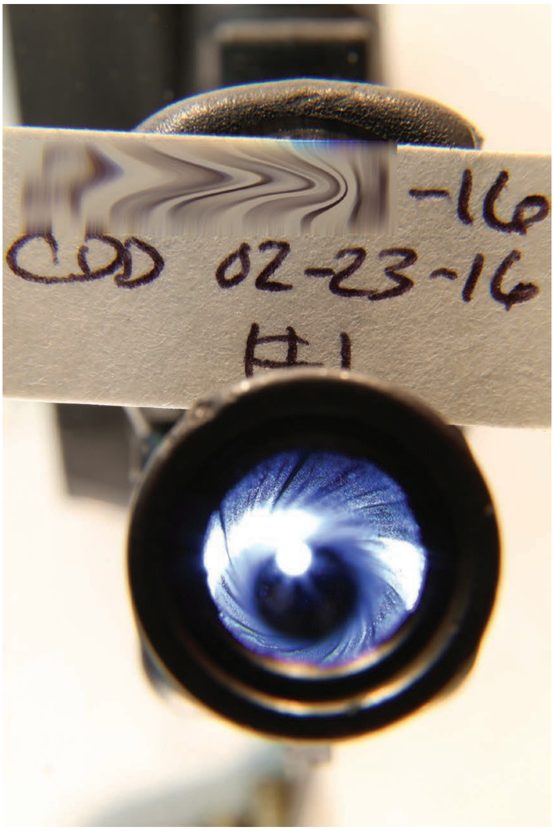


Figure 9.14 The interior lands and grooves of a pistol's barrel were illuminated in this figure by a single bulb LED flashlight. The exposure values were ISO 100, f/22, for 8 seconds. A very small aperture (f/22) was chosen to capture the greatest depth of field possible.

Once the evidence technician is happy with the DNA collections recovered from the weapon, the next task is to process it for latent fingerprints. Basic volcanic or graphite fingerprint powder can be used when processing most recovered weapons. However, there might be some wood or polymer surfaces that investigators might prefer to use an alternative method when processing. Each investigator can use their own training and experience when deciding what processes, they believe are likely to recover the most useful fingerprint evidence. Some investigators prefer to use cyanoacrylate (super glue) fuming for all their recovered evidence that are being processed for latent prints. This is completely acceptable, but the approval does come with one word of warning or request. Firearms examiners would appreciate if a piece of fingerprint tape was placed over both ends of the barrel to protect the interior of the barrel from being fumed. The likelihood may be very small that an overaccumulation of cyanoacrylate inside the barrel could fill in the minute imperfections of the barrel that leave a ballistic fingerprint on the fired bullet, but it does exist and firearms examiners would appreciate the taping effort to make their job a little easier.

Now that the weapon itself has been processed, the magazine or clip and the ammunition can be processed for DNA and latent fingerprints. Live ammunition is much more likely to contain DNA and fingerprint evidence. There have been rare cases of fired cartridge cases found to have DNA or latent fingerprints, but the act of firing the weapon can create up to 4000° F from the gunpowder's ignition and even though it only lasts approximately .0007 seconds, it is still enough to effectively burn off Touch DNA and fingerprint residue. In addition, the cartridge cases expand upon the gunpowder's explosion and more specifically for semi-automatic weapons, when the fired cartridge cases are extracted from the chamber, they scrape against the inside of the barrel, causing further destruction of the DNA and fingerprints that may have been present on the cartridge case. Although the likelihood of recovering usable fingerprints or DNA from a fired cartridge case, it is another case of making an earnest attempt in order to fulfill the requirement of doing everything one can to identify a shooter.

Live ammunition and the magazine or clip are much more likely to possess DNA and fingerprint evidence because they have not been obliterated by the firing process nor by any efforts of the suspect to wipe down the gun of any evidence. The evidence technician will have to look at the condition of the magazine or clip and decide what is more likely to yield DNA or fingerprint results. The ammunition needs to be unloaded from the magazine or clip and the headstamp information should be documented as each of the cartridges are removed. The investigator also needs to note the magazine's capacity, in addition to the total number of cartridges contained in the magazine or clip. As for the ammunition, especially larger caliber cartridges, they are likely to hold both DNA and fingerprint evidence and the investigator will have to decide which processes are done. Investigators can powder process for fingerprints and then swab for DNA, but they cannot process in the reverse order. The swabbing action will obliterate any latent fingerprints. Swabbing cartridges for DNA is fairly straightforward. However, evidence technicians should speak with their DNA laboratories and determine if they would like one pair of swabs for all cartridges in a magazine or if they prefer the swabbing samples collected from individual cartridges. Multiple cartridges may be swabbed on one set of swabs as long as the cartridges originated from the same source (magazine or clip).

As for fingerprinting the cartridge cases, cyanoacrylate fuming is generally a good place to start. Especially because that offers investigators additional attempts at tape lifting any found fingerprints. The additional attempts may be necessary because the rounded surface on the cartridges can be a challenge, even for seasoned veterans in the field of crime scene investigations. There is one trick that may help recover a quality tape-lifted print. The challenge to tape lifting prints off cartridge cases is that the small, rounded surface of the cartridge case makes it difficult to get the tape to roll smoothly over the entire circumference of the cartridge. Using the edge of a table or a straight piece of wood might help investigators with getting the fingerprint tape to lay smoothly on the cartridge case. The cartridge case's rim is what causes trouble, but by placing the rim of the cartridge over the edge of the table or board, the tape can be applied more evenly onto the surface. Pull out a few inches of clean fingerprint tape and lay it sticky side up along the edge of the table or board (Figure 9.15). One side of the tape should already have a dogeared end, but the investigator should dog-ear the opposite end of the tape or leave the tape attached to the roll. Holding the cartridge between the thumb and forefinger (bullet end and base end on the cartridge), place the cartridge down in the middle of the tape, with the rim hanging over the edge of the table or board. Try and get the center of the print face down so that the print makes the first contact with the tape. Next, carefully and slowly rock the cartridge back and forth in small increments until the fingerprint tape covers approximately the bottom half of the cartridge. One can also slide their finger underneath the tape to help the smoothing out of the tape onto the cartridge. Once about half the cartridge is covered with tape, the remaining half or top half of the cartridge can have the tape smoothly applied with finger pressure. The two tape ends are likely going to merge at the top of the cartridge. This is the purpose of having dogeared both ends of the tape. Next, the investigator can rub their finger over the entire cartridge and make sure the tape is fully smoothed out onto the cartridge's entire

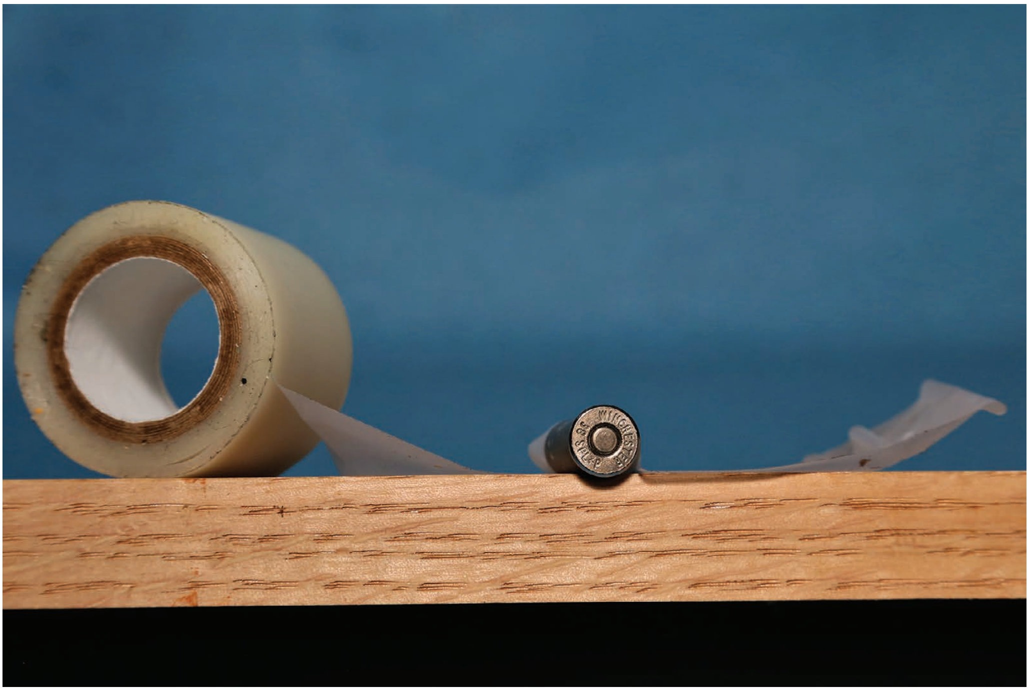


Figure 9.15 When tape lifting fingerprints from the cartridges or cartridge cases, it may be helpful to roll the cartridge along the edge of a table or board so that the cartridge's rim rests free over the edge, thereby allowing the casing's body to roll flat against the tape.

surface. The tape can be removed by slowly pulling the two dogeared ends of the tape apart and away from the cartridge. The tape can then be placed onto a latent print fingerprint lift card.

Weapons and live ammunition are not the only pieces of ballistic evidence that are commonly found in vehicles. Fired cartridge cases and fired bullets are also routinely sought for and found inside cars and trucks. The recovery of these items is somewhat more difficult than relatively large weapons, because fired cartridge cases and projectiles tend to bounce, roll, deflect, and basically do everything they can to make finding them a nightmare for investigators. These small pieces of evidence have a mind of their own and do everything they can to hide from an investigator. The best piece of advice is to never give up searching for ballistic evidence if you still believe it is in the vehicle. At the very least, one will want to explain to the jury that they did everything possible to find the missing object. The search efforts should also be documented in the investigator's report. If it is not written down, then it did not happen.

When firearms are located inside a vehicle, it is likely they were fired in the course of the criminal act and fired cartridge cases and shotshells may be found inside or on the vehicle somewhere. The challenge for investigators is to locate all the spent casings because they can roll or bounce in a number of directions. In addition, the suspect may have tried to conceal the potential evidence or during their escape from the scene, drove recklessly, and cause the fired cartridge cases to move into an unexpected location. Consequently, the investigator must complete a thorough search of the vehicle, peeling away pieces of the vehicle as necessary. For example, pulling up floorboard mats and even the removal of seats may be required to find hidden fired cartridge cases. Casings may also be found on the exterior of the vehicle, like in the back of an open pick-up truck bed. Another area where casings like to find themselves lodged is along the back edge of the front hood, just below the windshield. Casings are frequently found trapped along the window wiper blades or the backside of the engine (Figure 9.16). Investigators should make it a habit to check these areas for spent casings.

When individual casings are found, like the one seen in Figure 9.16, they should be marked with an evidentiary placard. Each individual fired cartridge case or shotshell should have its own evidence identifier or placard. The number or letter identifier should be used throughout the vehicle's processing. It will become clearer a little later in this chapter, but it is recommended that investigators use numbered evidence markers. As a brief preview, the tracking of fired bullets through vehicles will use a letter–number combination in order to denote the sequence of surfaces impacted by a fired bullet. As a result, if an investigator would choose numbered placards for loose items of evidence, it will make for a more organized examination of the vehicle. Consistency is key to the quality documentation of the vehicle. Photographs, reports, diagrams, and packaging should all maintain consistent labeling and identification. Evidence markers and photography is covered in greater detail in Chapter 5. The major difference between evidence markers used in the field and those used with vehicles is the size of the placard. Because of a vehicle's smaller environment, smaller evidence markers are better for photographing purposes.

Fired bullets are even more diabolical than casings when it comes time to locate them inside a vehicle. Fired projectiles that enter a vehicle can be tracked and hopefully found through the use of a trajectory rod. Trajectory rods can be slid into perforations found on the vehicle and they will point in the direction of the fired bullet's path of travel. The identification of the perforation's entry and exit holes will be discussed a little later. For now,

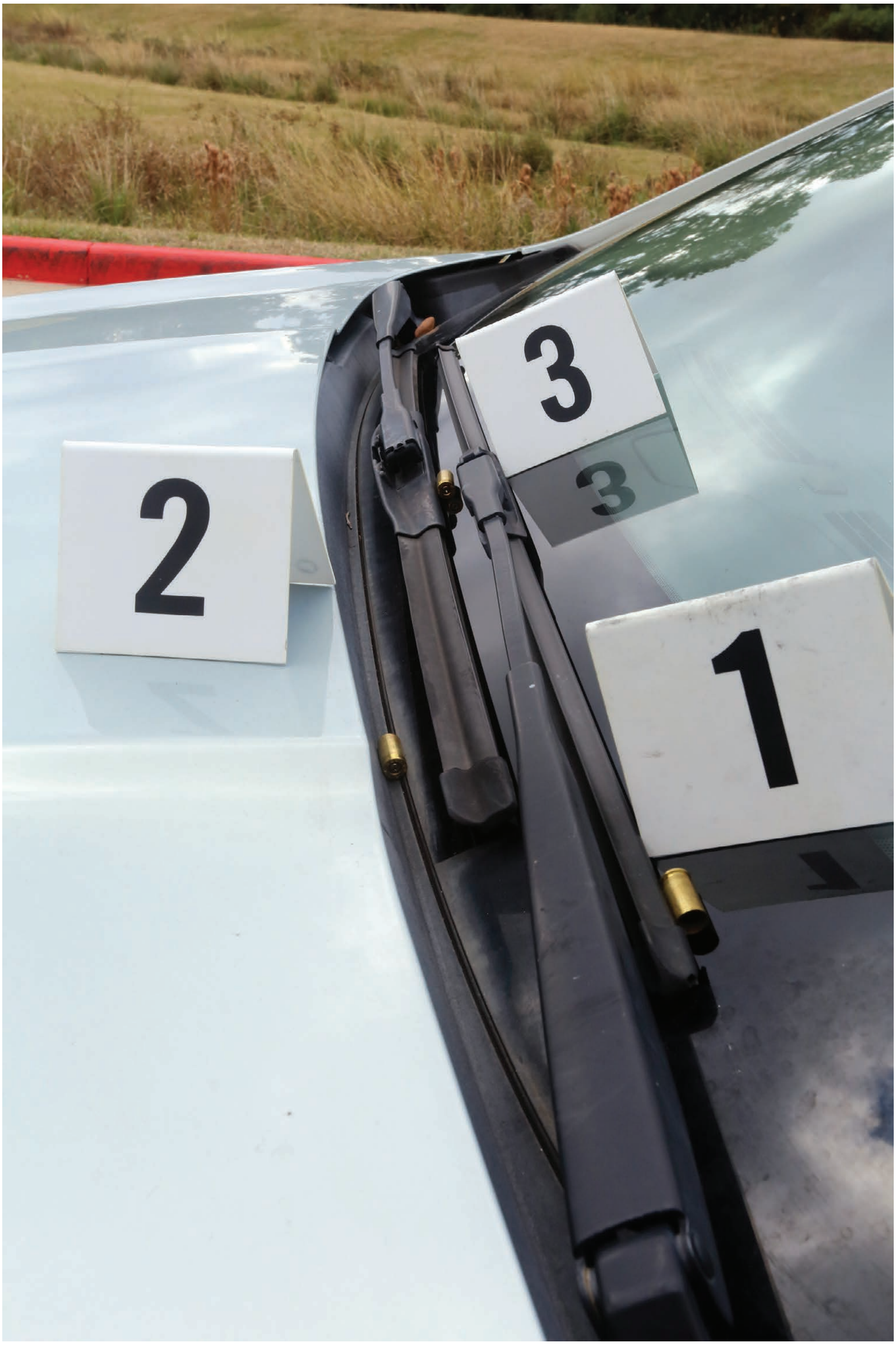


Figure 9.16 Fired cartridge cases that are fired outside of a vehicle can often land on the windshield and roll down below the back edge of the hood. As a result, it is not uncommon for fired cartridge cases to become trapped along the wiper blades or the upper back of the engine compartment.

determining where bullets have traveled can be made easier by following the path of a bullet by sliding a trajectory rod into the exterior bullet hole and seeing where it leads. This is very helpful when a fired projectile passes through a vehicle's door and enters an upholstered part of the vehicle, such as a car seat or trim portion of the vehicle's interior. This may seem a little simplistic, but when fired projectiles enter fabric, leather, or similar surface, the hole created by the bullet can close up and look like a very small cut in the surface and not appear anything like a round bullet hole (Figure 9.17). Fired bullets will do amazing disappearing tricks and investigators must not give up when searching for fired projectiles. A perfect example of this is when a fired bullet enters the vehicle's roof liner. Many liners are mounted to a sturdy cardboard backer board. When the bullet passes through the backer board, but does not have enough energy to punch through the metal roof, it can bounce around in the space between the metal roof and the backer board. Investigators can always hope to feel the fired projectile in the roof liner by running their hand across the liner, but many times the entire liner will have to be pulled out so that the fired bullet can be located (Figure 9.18). An important reminder when recovering fired bullets from any surface, it is best to collect them with gloved fingers and not any sort of metal tweezers, pliers, or other metal tools. The metal tools can damage the small imperfections caused by the barrel's rifling that are found on the fired bullet. The damage could prevent a firearm's examiner from matching the projectile with the weapon it originated from. If for some reason, one cannot get their fingers into a small crevice possessing a projectile, one can place some plumber's putty or other tacky material onto the end of a wood dowel or trajectory rod and try and pick the bullet up by getting it stuck to the tacky material. If that does not work, one can use plastic or rubber-tipped tweezers. In

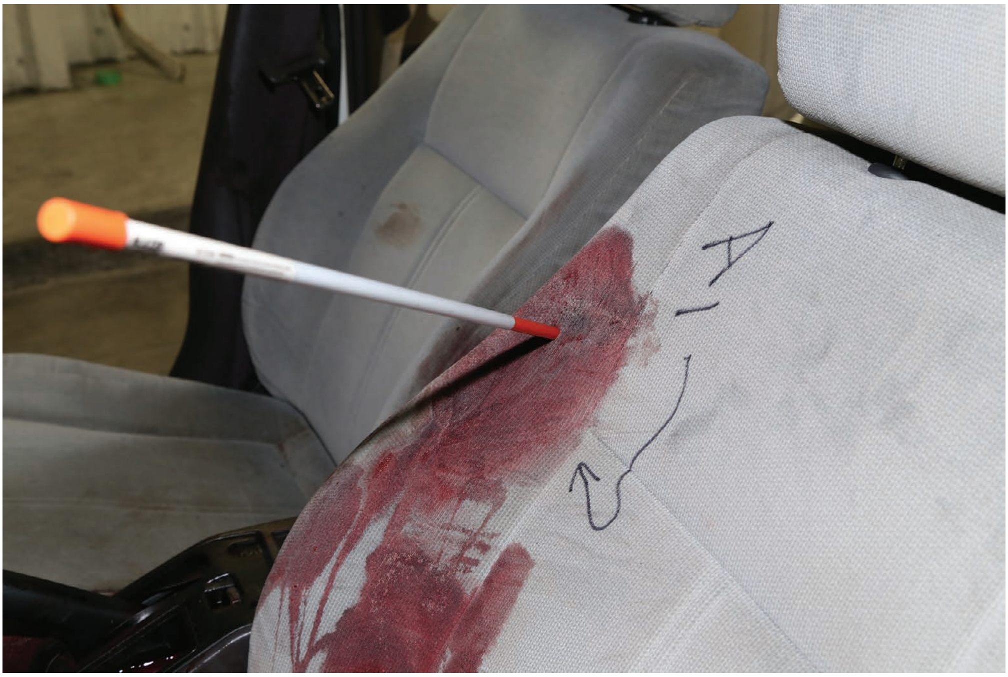


Figure 9.17 Fired bullets that pass through softer materials can close up and appear more like a small slit rather than a round hole. Without any context provided by a trajectory rod pointing out the bullet defect, it may be hard for a photograph's viewer to spot the small cut.

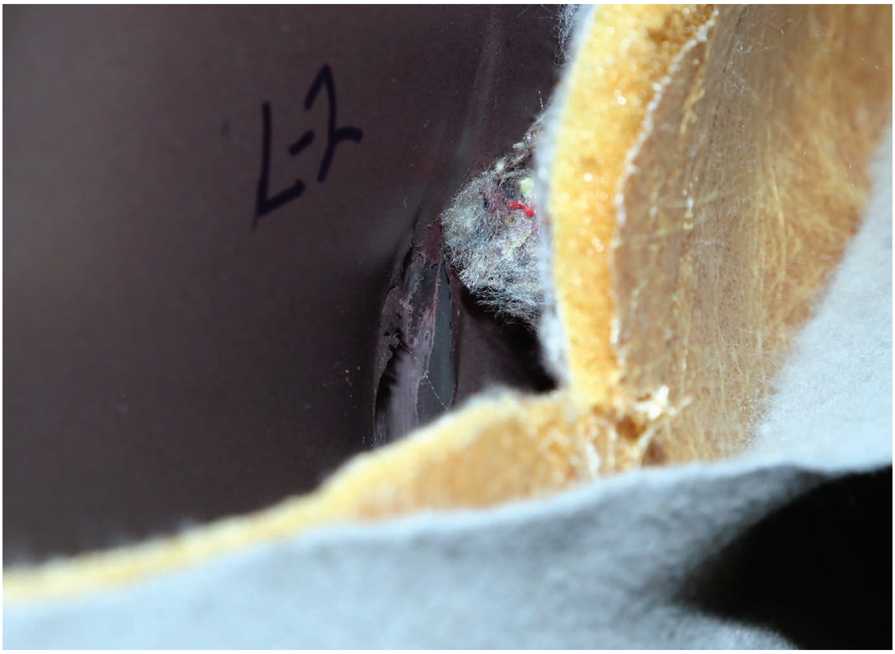


Figure 9.18 Fired bullets that get trapped in between a headliner's backer board and the metal roof often require the removal of the roof liner in order to recover the fired projectile. The fired bullet in this photograph passed through the headliner and deflected off the metal roof at "L2," which was above the driver's seat The fired bullet was recovered along the roof's edge by the back door's window.

the end, investigators should try to recover evidence in as pristine condition as possible, but the numerous metal surfaces on a vehicle can make that a challenge.

Removing the vehicle's headliner to find a fired projectile is not the only destructive act examiners will do in order to recover fired bullets. When a fired bullet enters a vehicle's upholstered seat and it does not appear to exit, the evidence technician will need to cut into the seat to recover the projectile. Cutting into the seat should be systematic and follow the track of the fired bullet (Figure 9.19). Do not forget to photograph the fired bullet where it was found prior to recovering it. The foam seating, especially in more expensive vehicles, can seemingly seal up behind the bullet, creating great difficulty in following the bullet's path. In those cases, the investigator can cut or pull out the foam padding from the vehicle. The investigator can use a metal detector to locate the bullet inside the foam. Sometimes this is not as simple as it sounds and the trick is to cut the foam seating in half, finding which half responds to the metal detector. Keep cutting the leftover piece of foam in half until the fired bullet is eventually found. The metal detector cannot be used inside the vehicle, because of the metal springs and frame of the vehicle's seat. If a metal detector is not available, the evidence technician will need to cut thin slices of the foam until the fired projectile is located.

Another example of having to cut open part of the vehicle in order to recover fired bullets occurs when a fired bullet penetrates a vehicle's tire. Anytime a vehicle has been shot up and has a flat tire, the investigator should examine the tire for a bullet hole. The vehicle should be placed on jacks or lifted on the car lift so that the wheel can spin freely. The investigator may hear the bullet bounce around inside the tire. Most tires are steel-belted tires and the best way

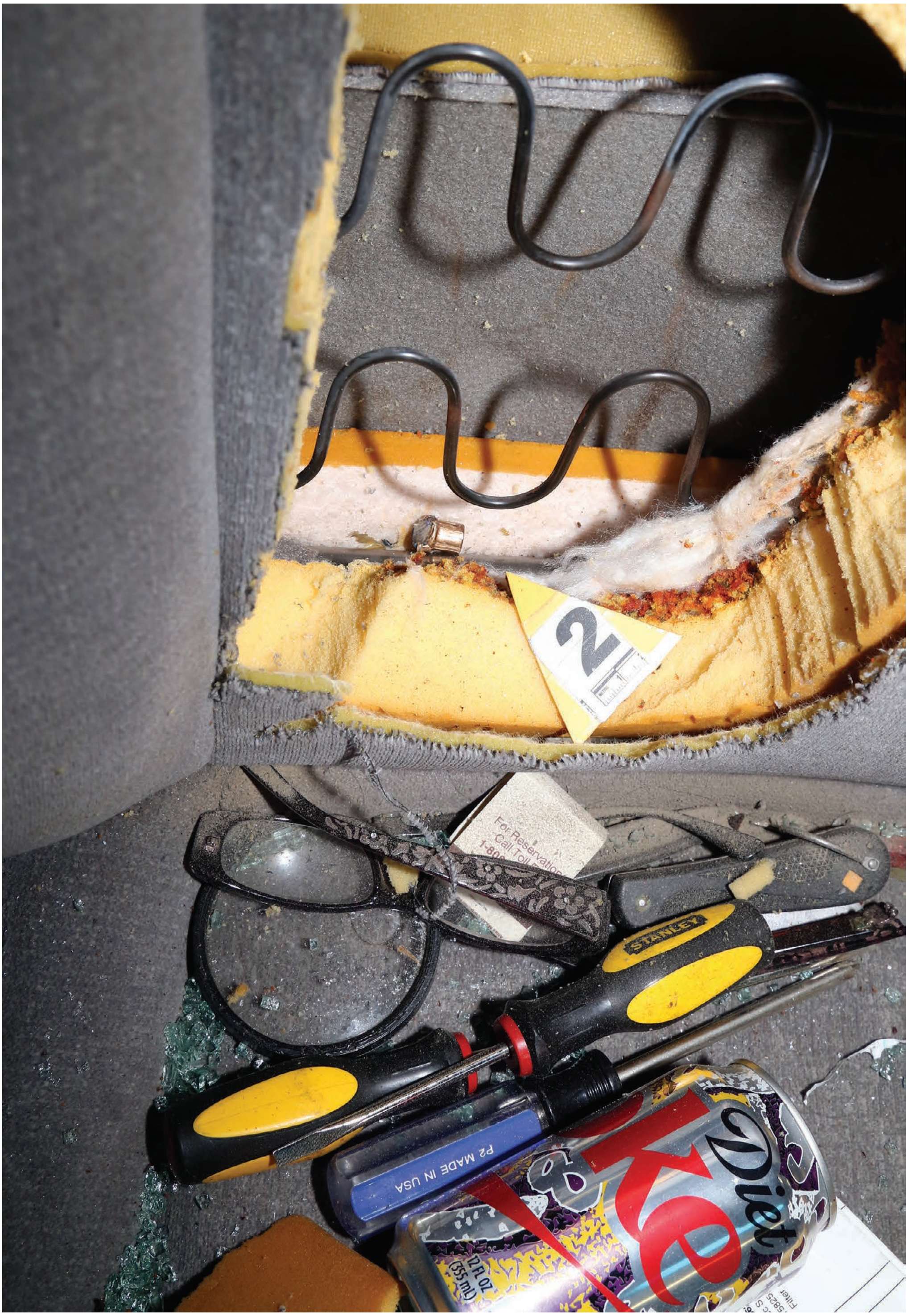

2
STANLEY
P2 MADE IN USA
Diet
12 fl oz (355 ml)
For Reservation
Call Toll
1-80

Figure 9.19 A fired bullet entered this car's seat and was recovered from inside the seat's padding. Follow the track of the bullet's path closely from the entry point so that the bullet can be more easily found. It is not uncommon for the foam to close up behind the traveling bullet, leaving only a small trace of the path in which it traveled.

to gain access to the interior of a tire is by cutting a hole in the sidewall (Figure 9.20). A sharp pocketknife is generally enough to cut into a tire's sidewall. Vehicle doors are also commonly struck by fired bullets. When these projectiles penetrate the door, but do not exit, the bullet can be found inside the door. Investigators should be clear on the difference between penetration and perforation. Perforation occurs when the fired bullet passes completely through an object. Penetration occurs when the fired bullet enters the object, but does not exit. Removing the interior door panel involves removing all the screws holding the panel to the door. The screws may be hidden behind small plastic tabs that need to be pried off with a small screwdriver. Many door panels are also held on to the door with plastic pop-rivets. Vehicle trim pry tools are perfect for pulling the pop-rivets out, without damaging the vehicle any further. Be careful when removing the interior door panels because it is likely wired to the door's window motor and door locking systems. The wire harnesses must be unclipped to fully separate the door panel from the door frame. Once the door panel is pulled off, the investigator will also have to peel off the plastic vapor barrier to gain access to the door frame's interior. With any luck, the investigator can look inside the door and see the fired bullet, but more likely, they will have to contort their arm in strange positions to feel along the bottom of the door's interior or bottom edge to find the bullet (Figure 9.21). If the tempered glass window was shattered inside the door, feeling for the fired bullet can be dangerous. One possible solution is to use a wet/dry vacuum to suck out the contents of the door's interior, all the small shattered squares of tempered glass, along with the fired projectile(s). The vacuum should be used solely for evidence recovery, because if it is used to clean the shop, the fingerprint powder will clog up the filter and make the vacuum less effective. Make sure the wet–dry vacuum's collection bin is clean and free of any other debris and just place the hose inside the door's frame to suck up the loose contents. The wet/dry vacuums have a great deal of suction power and can easily pick up glass and projectiles.

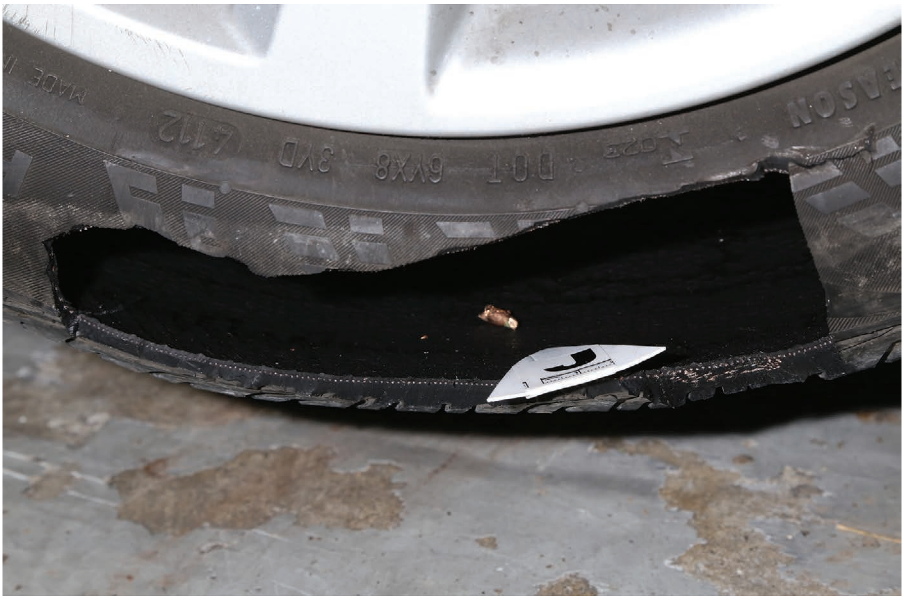


Figure 9.20 An investigator will need to cut into the sidewall of a tire using a sharp knife in order to gain access to the tire's interior cavity. The hole needs to be large enough to record a quality photograph and large enough for one's hand to reach in and pick up any projectiles.

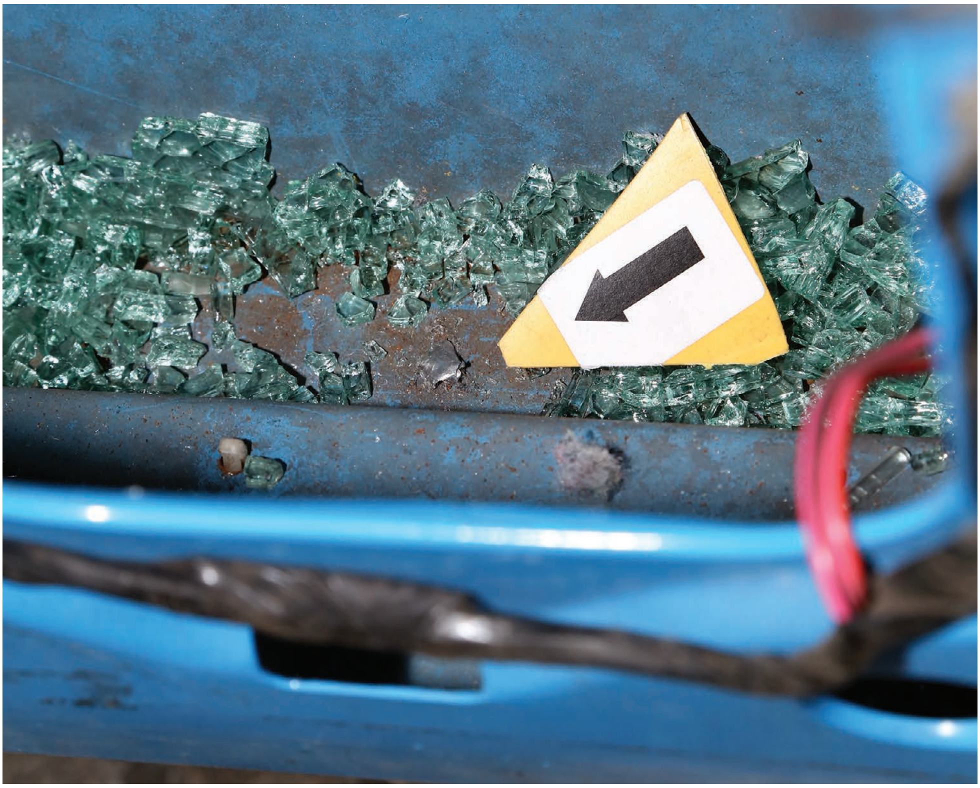


Figure 9.21 Once a vehicle's interior door panel is removed, the evidence technician will have access to the door's interior and can search for the fired projectile along the bottom edge of the door's frame. In this photograph, one can see how small bullet fragments may become after breaking apart from its impact with the metal door.

Recovering fired bullets from inside vehicles can pose numerous difficulties to examiners, everything from deflected bullets traveling in a completely unexpected direction to bullets breaking up upon impact with a vehicle's exterior surface. Larger caliber bullets, especially hollow point type ammunition tend to have the metal jacket separate from the lead core (Figure 9.22). These two parts can end up in the same general location or two completely different locations. In addition, it is also possible that the metal jacket may hang up on a vehicle's surface, while the led core continues traveling on its original trajectory. Investigators have to be careful when tracking projectiles and be aware of this possibility. If bullet fragments from the same projectile are found in the same general location, they can be packaged together. However, if they are separated and found apart, then they should be packaged separately. A firearm's examiner can determine if the pieces belong together, but the crime scene investigator should play it safe and not assume that the two pieces definitively came from a single source. Smaller caliber rifle bullets, that are traveling at higher velocities, tend to shatter quite a bit upon impact with a hard surface and break up into numerous pieces (Figure 9.23).

On occasion, a fired bullet will become trapped in between two pieces of sheet metal. A car's trunk or a pick-up truck's rear bed is an excellent example of this. The rear quarter panels on these types of vehicles have the exterior side of sheet metal, but there is also an

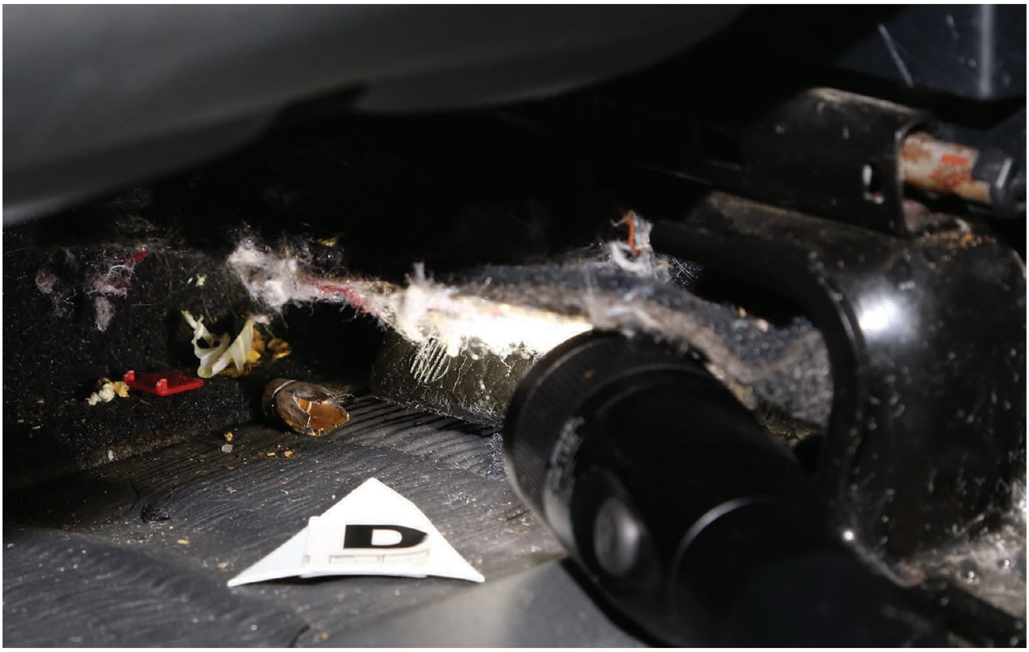


Figure 9.22 Metal jacketed types of ammunition may separate upon impact with the vehicle. In this photograph, notice how the lead core has separated from the metal jacket found underneath the seat of this vehicle.

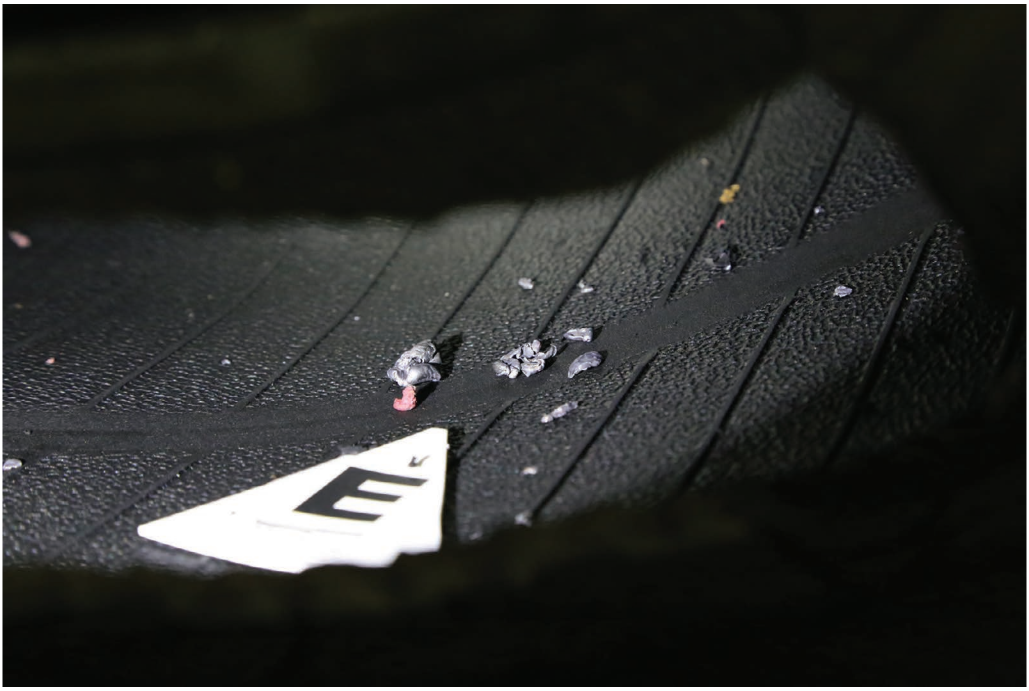


Figure 9.23 Higher velocity projectiles tend to fragment in numerous pieces upon impact with hard surfaces. This 7.62 × 39 mm fired bullet entered a car's tire and fragmented into numerous smaller pieces.

interior panel of sheet metal that is designed to protect the exterior side from damage by shifting or moving cargo that is being transported in the vehicle. When a fired projectile has enough energy to perforate the exterior sheet metal, but does not have enough energy to penetrate the interior panel, it becomes trapped in between the two. The decision to go after the fired bullet by cutting open side of the vehicle is a decision best decided through a mutual decision among the criminal investigator, the evidence technician, and the vehicle's owner. The removing of already damaged car seats and interior door panels that can be easily replaced is one thing, but cutting into the vehicle's sheet metal will have to be determined by how important the fired bullet is. If the vehicle was struck multiple times and the investigator recovered numerous fired bullets with excellent rifling characteristics, then maybe the one fired bullet trapped inside the vehicle is not worth the damage caused by its recovery. However, if a single fired bullet perforated the victim's head, killing them, and then passed through one panel of sheet metal, becoming trapped inside the vehicle, then that fired projectile is most likely worth the damage caused to the vehicle. If the vehicle is insured, then it will likely be repaired anyway. However, that is the purpose of consulting with living victims and determining just how far the investigator is allowed to go in order to recover all the potential evidence.

Documentation of Vehicles Struck by Fired Projectiles

The documentation of vehicles struck by fired projectiles is definitely a time-consuming endeavor. It cannot be rushed, and it must be complete. The full documentation of a vehicle may become vitally important when combined with the original scene investigation and a full reconstruction of the incident occurs. If the vehicle is not properly documented, then a crime scene reconstruction may not be possible or at the very least, its quality will be limited. Written notes about the vehicle must be recorded. Investigators must not rely on their memories. Some investigators may use photographs to record notes, such as a license plate number or the height of a bullet strike. However, that is up to the investigator and what their individual agency allows. However, a good rule to work by is "if it is not written down, then it did not happen." Measurements are critical in the examination of a shot-up vehicle. Measurements will include length measurements, as well as angle measurements. A complete set of measurements may include the following:

- Overall vehicle measurements
- Positions of bullet strikes and defects
  - Front to back/back to front
  - Right to left/left to right
  - Up from the ground
- Vertical and horizontal angles of impact

These measurements are made more numerous as additional surfaces are impacted by fired projectiles. Bullets do not always stop after they perforate the exterior surface of a vehicle. Not every measurement can be recorded for every bullet defect, especially when it comes to angles of impact. Vehicles are not like the walls of a house; they have curves and bends in them and those can make angle determinations difficult at best. However, the more information recorded, better the chance to gain some insight into what exactly happened during a shooting.

Crime scene investigators may use the recorded measurements to complete a scale diagram of the vehicle. Depending on what kind of resources an agency has, the investigator may be using a computer program to make their drawing, like CrimeZone or CrashZone, or they may simply create diagrams the old-fashioned way, by hand. Whichever method is used, vehicle examiners might find it efficient to have some predrawn templates available for the different types of vehicle body styles (Figure 9.24). If an investigator receives a unique vehicle to process or an investigator does not routinely work on vehicles, they can simply hand draw an outline of the automobile. The vehicle templates simply make the note taking more efficient and neater.

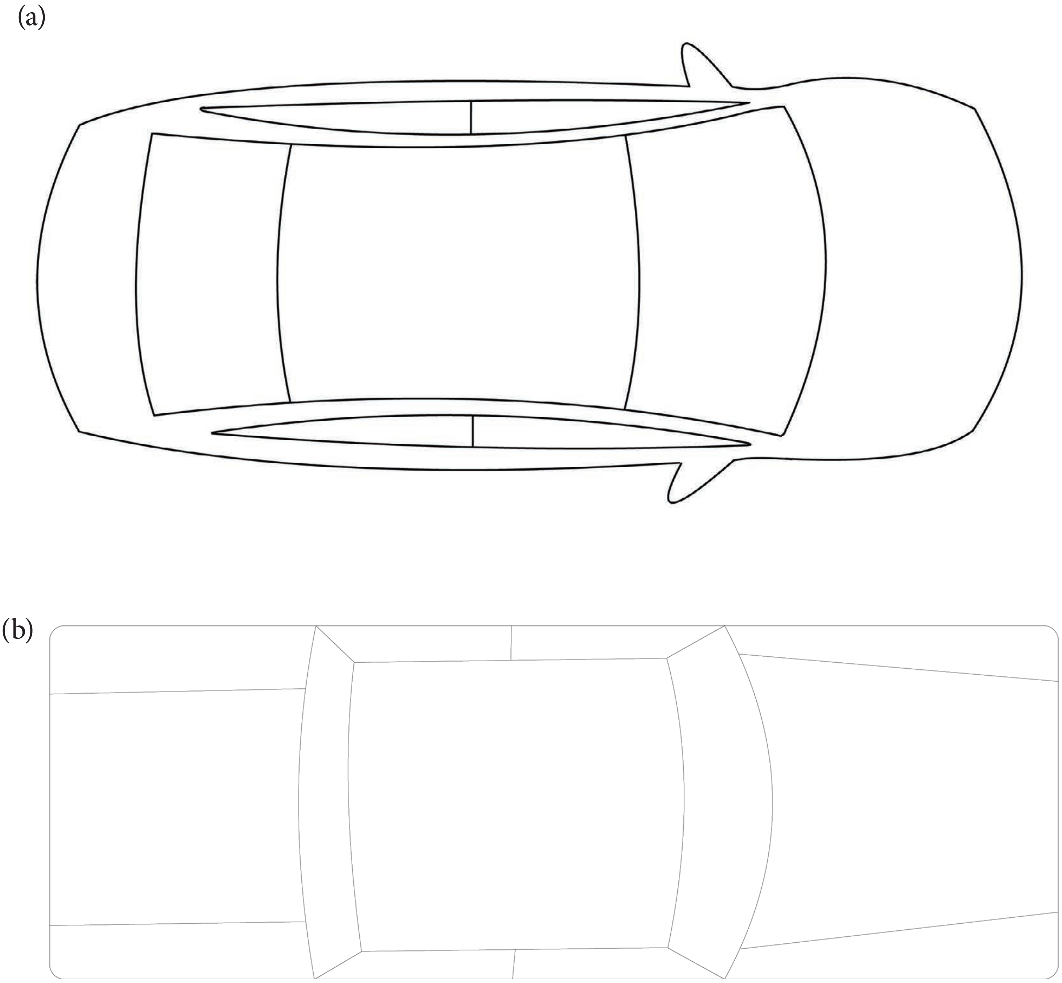


Figure 9.24 Investigators who routinely work on vehicles may find it efficient to have a set of vehicle templates to use when diagramming a vehicle. These templates can be used to neatly record notes about the evidence found on and in an automobile. For example, the following are a selection of overhead views of common vehicles found on roadways: (a) two-door coupe and (b) four-door sedan. These templates can be easily modified for unique characteristics, such as passenger vans and cargo vans.

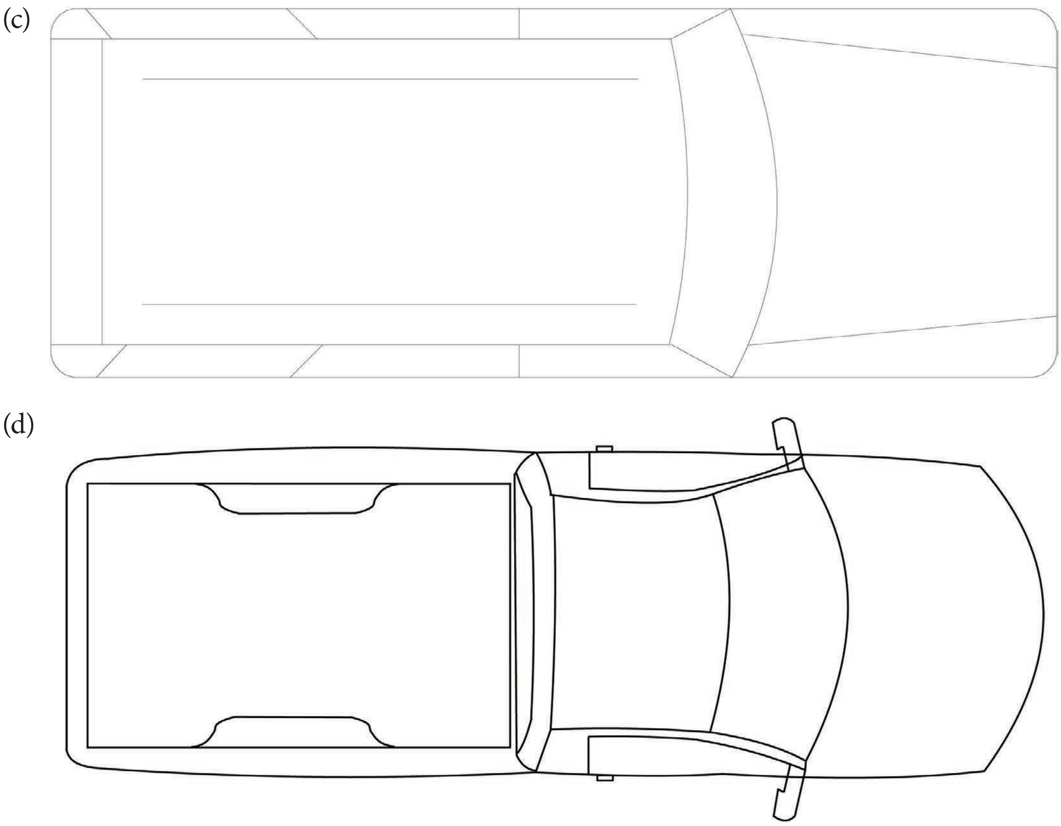


Figure 9.24 (Continued) For example, the following are a selection of overhead views of common vehicles found on roadways: (c) sports utility vehicle, and (d) pick-up truck.

Investigators will need a few important items before recording handwritten notes about a vehicle's examination. Beyond a vehicle template and plenty of clean paper, the investigator will want an assortment of colored pens to record the information. Different colored pens can help understand rough sketches. The vehicle and its features can be drawn in black ink, while overall measurements can be written in blue ink, while evidentiary measurements can be written in red ink. The different colored inks simply help make the handwritten notes a little easier to read and decipher. Having two or three tape measures available will make the documentation process much easier as well. One of the tape measures should be at least 25' in length. A yardstick or similar rigid measuring device helps measure vertical distances, but the third tape measure can be substituted just as easily. A zero-edge protractor and an analog or digital angle finder will be necessary to measure the vertical and horizontal angles of impact. Finally, a set of trajectory rods should be at the investigator's disposal. They help determine the flight paths of projectiles striking the vehicle.

Measurements start with the overall dimensions of the vehicle. The width and length of the vehicle, as well as the tires' centers, should be measured. Since so many potential measurements are going to be recorded, it would be advantageous to pick one corner of the vehicle and make that the reference point for all recorded measurements using the rectangular coordinates method of plotting those measurements. Make sure the reference point is notated on the template or the investigator's written notes. Without another reason, the chosen corner can be the closest one to the area containing the majority of bullet defects and/or evidence. Next, lay the tape measures on the ground, placing the zero-increment marks together, 90° to each other and at the vehicle's reference point. Run the tapes along the full length and width of the vehicle. These tape measures will be used to measure all the X and Y dimensions recorded using the rectangular coordinates method of plotting. The tape measures can remain on the floor as the investigator moves around the vehicle recording their measurements. When recording measurements and angles, investigators might appreciate making tables or charts to help organize the note-taking process. Something like the chart below will help keep all recorded measurements organized and easily recalled.

Impact Site	**Forward (F) or Back (B) from R.P.**	**Horizontal Angle of Impact**	**Height of Impact Site**	**Vertical Angle of Impact**	**Notes About Trajectory**
A-1					
B-1					
C-1					
D-1					

An important part of documenting the flight paths of fired bullets is to maintain a consistent labeling process. Labeling or identifying bullet strikes should be done consistently through notes, written reports, and crime scene photographs. Bullet strikes, bullet defects, and impact sites all refer to the location where a fired bullet is believed to have impacted a vehicle. Generally, simplicity is a good philosophy in the documentation process. However, investigators should not abbreviate bullet strikes with the initials "B.S." in their notes, written reports, or crime scene photographs. A jury should not have to guess what "B.S." refers to; they may believe the investigator is providing a profane opinion of the vehicle. The goal of labeling and marking any crime scene evidence is to make the vehicle fully understandable to someone who was not present at the location. Beyond clarity, sequentially labeling evidence and being consistent with labeling practices will help improve the overall vehicle's documentation, from the crime scene photographs to any scale diagrams completed. Every investigator has their own techniques and methods of labeling evidence. Because of the complex nature of shooting incidents and the multiple types of surfaces which evidence can be found embedded into or lying on, the investigator may find that differentiating evidence found on horizontal surfaces (floorboards, seats, inside trunks, etc.) from vertical surfaces (doors, windows, seatbacks, etc.) may be beneficial. Physical evidence found inside the vehicle can be marked with numbered evidence markers. However, evidence such as bullet strikes or important bloodstains that are found on more vertical surfaces should be labeled with a letter identifier. In this way, the investigator immediately knows that if questioned about an item of evidence with a number identifier, then the item was found loose or on a horizontal surface. If the item in question possessed a letter identifier, then it was found on a vertical surface. Furthermore, because bullets are very likely to pass through multiple surfaces before coming to a stop, the labeling of bullet strikes can be labeled sequentially: A-1, A-2, A-3, etc. For example, a fired bullet that passes through the passenger compartment of a vehicle might be labeled as follows A-1 through A-5 to document all the surfaces the fired projectile passed through (Figure 9.25).

Working from outside to the inside and from the general to the more specific, the impact sites on the vehicle's exterior should be identified first and marked as A-1, B-1, C-1,

(a)

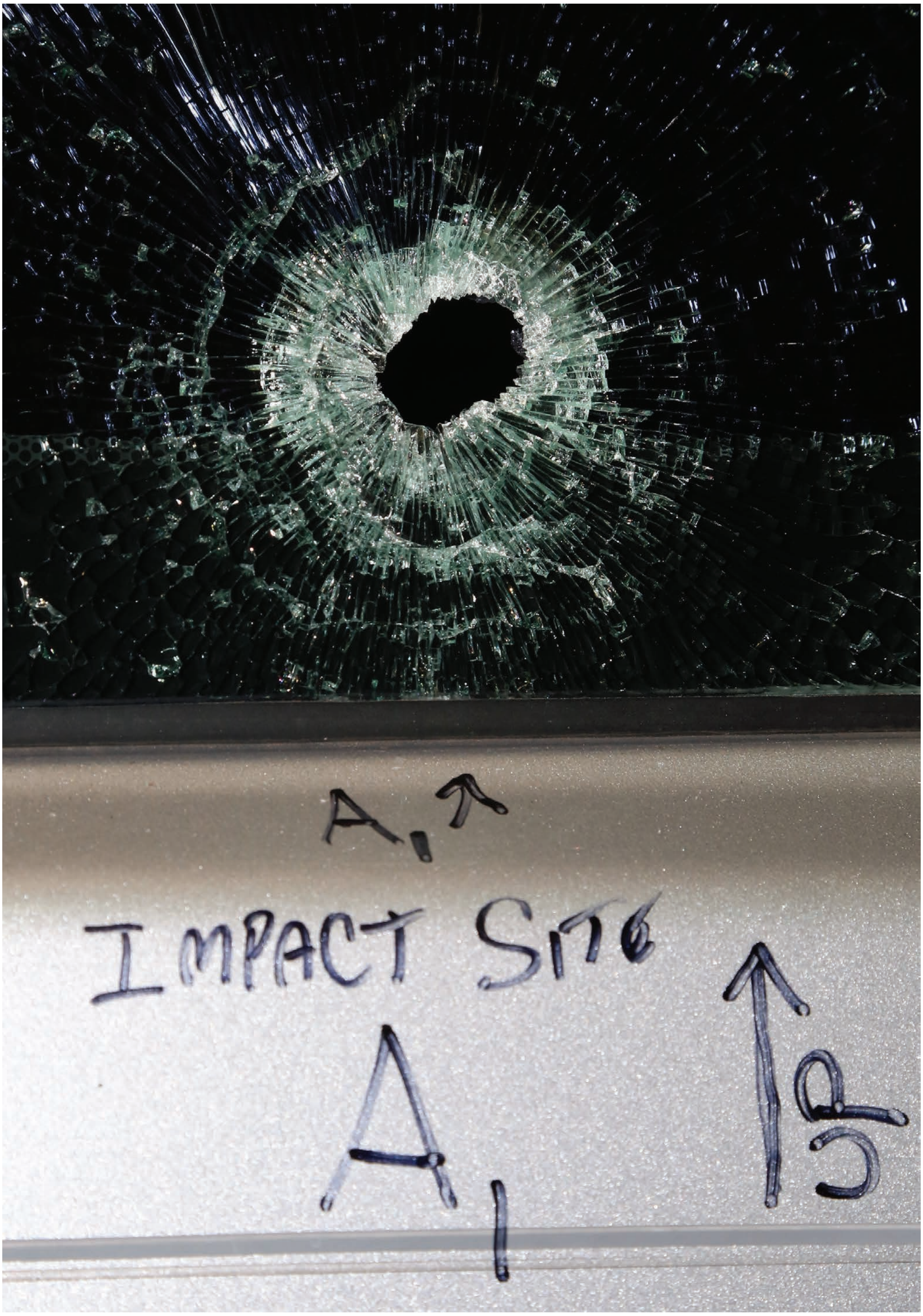
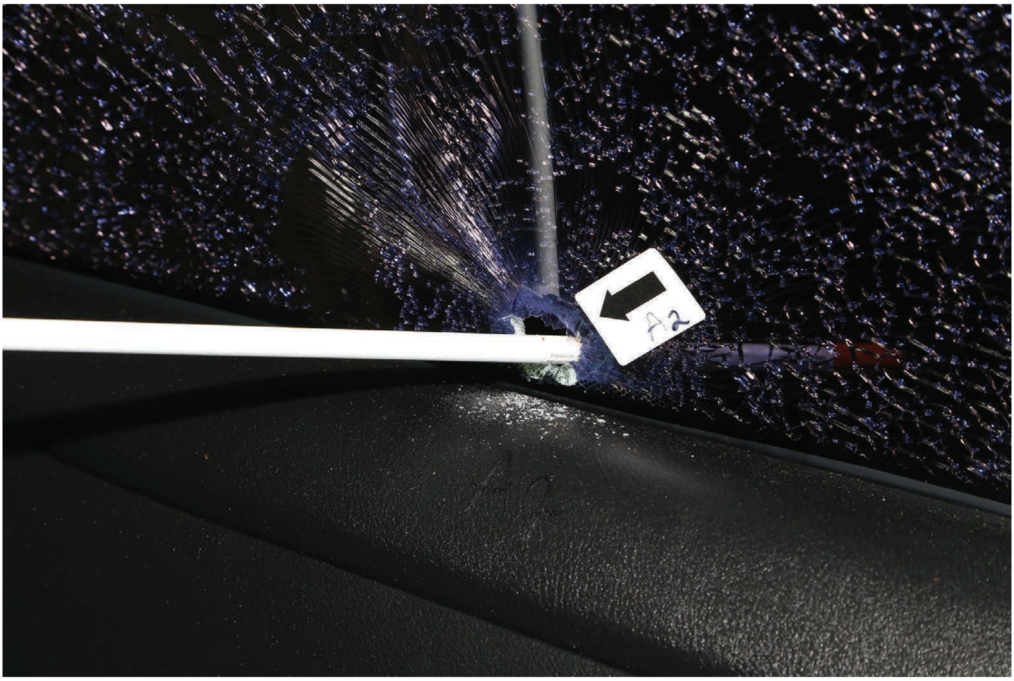

A1
IMPACT SITE
A1
B5

Figure 9.25 (a) A fired bullet entered the back-left passenger's door window at A-1.

(b)



(c)

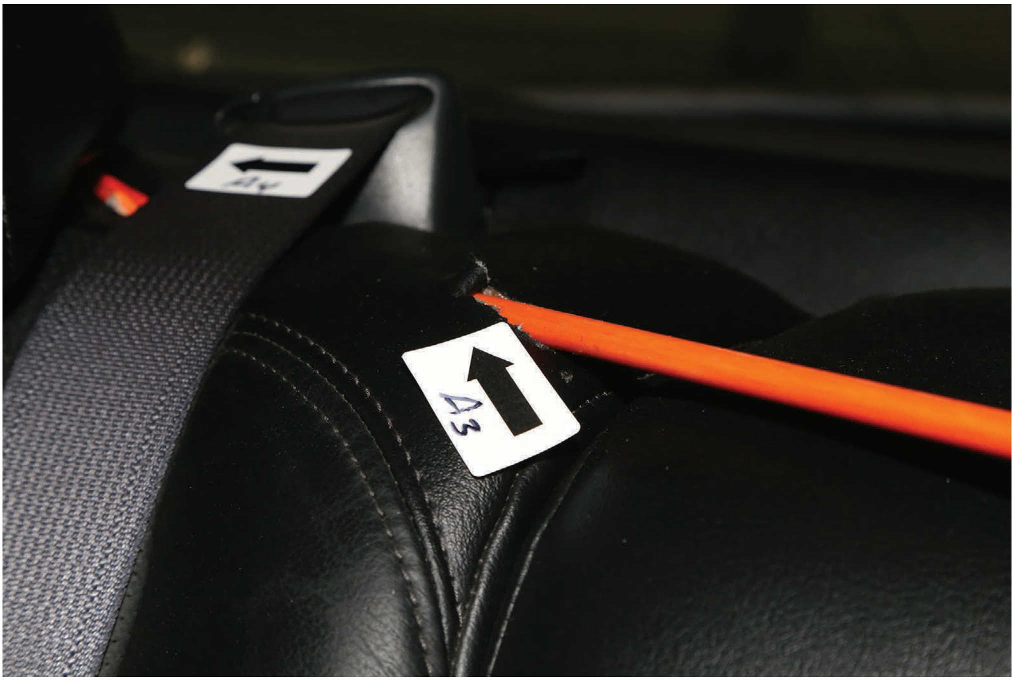
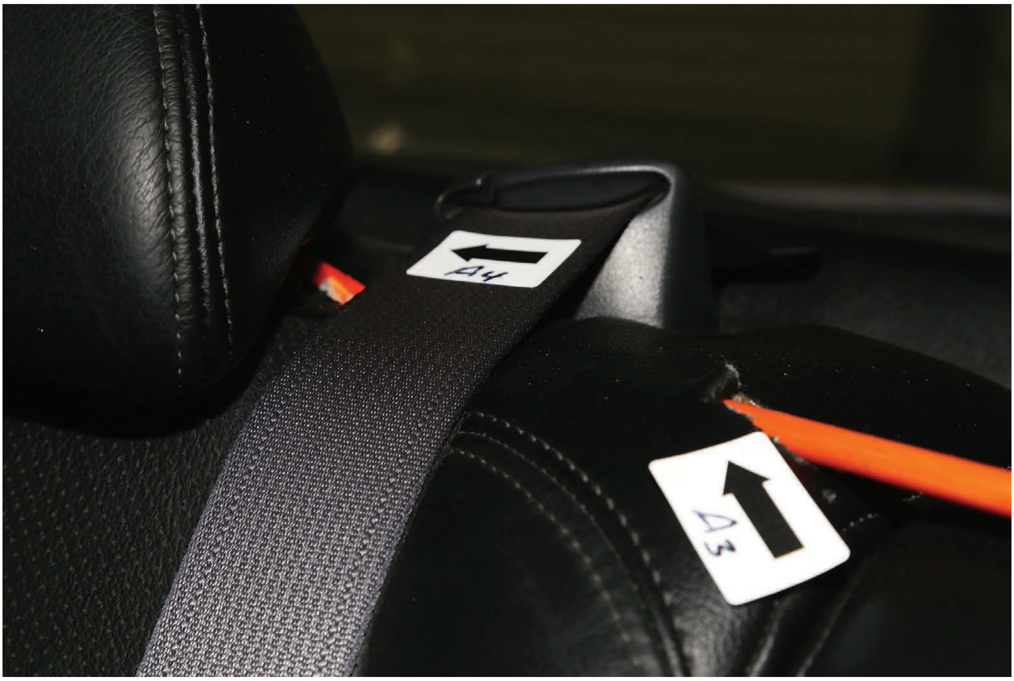


Figure 9.25 (Continued) (b) The bullet exited the window at A-2 and entered the passenger's compartment of the vehicle. (c) and (d) The bullet entered the back-right passenger's seat at A-3 and exited the rear of the seat at A-4.

(d)



(e)

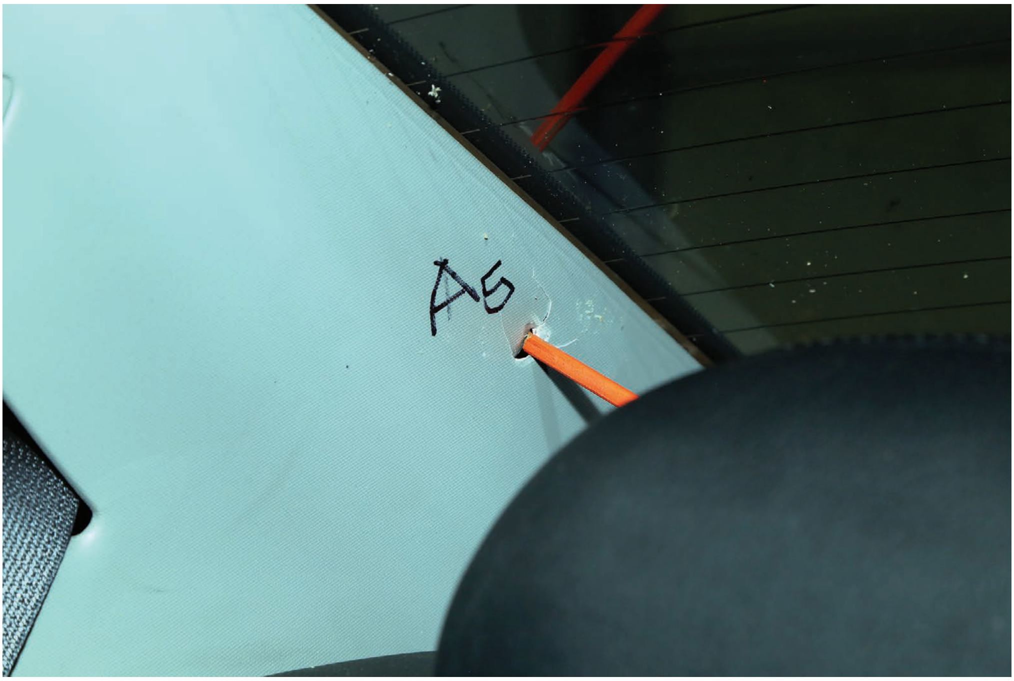


Figure 9.25 (Continued) (c) and (d) The bullet entered the back-right passenger's seat at A-3 and exited the rear of the seat at A-4. (e) The fired bullet continued across the back seat in a left to right trajectory and struck the interior side of the vehicle's "C" pillar.

(f)

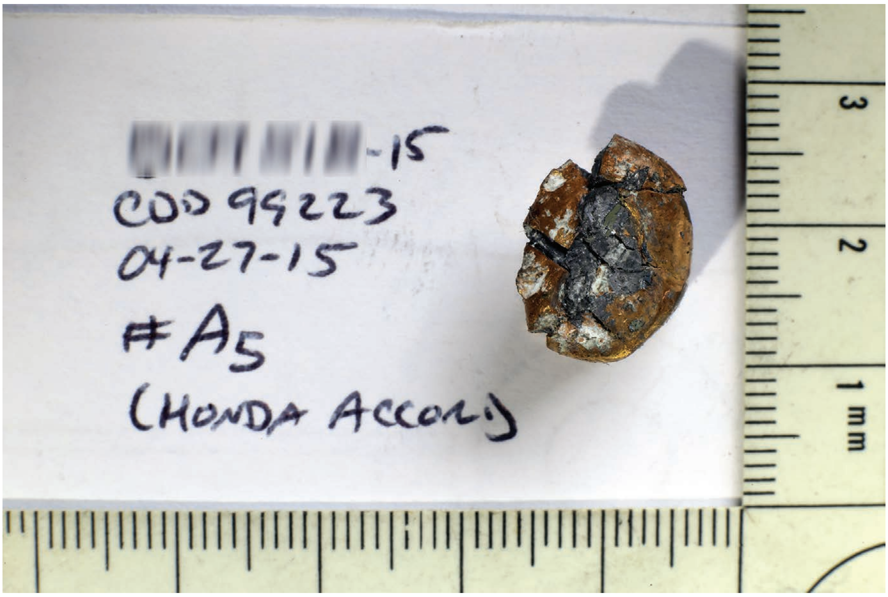


Figure 9.25 (Continued) (f) The fired bullet was recovered from behind the plastic interior trim and was tagged into evidence as Item #A-5 in order to maintain consistency in the evidence's documentation.

etc. Crime scene supply companies offer for sale preprinted stickers that are perfect for the labeling process. Other options include using a Sharpie permanent marker or taping an index card next to the bullet strike and notating the impact site's identifier. The subsequent surfaces impacted by the fired projectiles may be marked at this point or later, as the investigator moves from the exterior side of the vehicle to the interior portion of the automobile. The interior portion of the vehicle can be a little more difficult to mark impact sites because of blood-covered surfaces, colored surfaces, or odd-shaped surfaces (Figure 9.26). Once all the impact sites have been found, it is time to start recording all the necessary measurements. As a general rule, it is more efficient to take all the exterior notations and measurements first and then move to the vehicle's interior, plotting each trajectory individually.

To begin the measuring process, the vehicle should be looked at from the driver's point of view. Toward the front or forward refers to the frontward direction toward the front bumper. Toward the rear refers to a rearward direction toward the rear bumper. The driver's side refers to the left side of the vehicle and the passenger's side refers to the right side of the vehicle. Of course, this may be opposite in vehicles sold to consumers outside the United States. Investigators can now set out and record the forward/back and left/right measurements, as well as the height measurements in an articulate manner. The exterior bullet strikes found on the sides of a vehicle are measured back or forward of the chosen reference point. Evidence technicians can use a yard stick placed directly under a bullet defect and with the yardstick perpendicular to the tape measure that is on the floor, they can record an accurate forward or rear measurement. For bullet strikes on the front or rear of the vehicle, the process is the same, but the measurements are recorded as occurring right to left or left to right. The bullet strikes that impact along the vehicle's side may have a 0'–0" right or left measurement because they are found on the outer edge of the vehicle. However, many vehicles have curved body panels and not every surface is flush with a

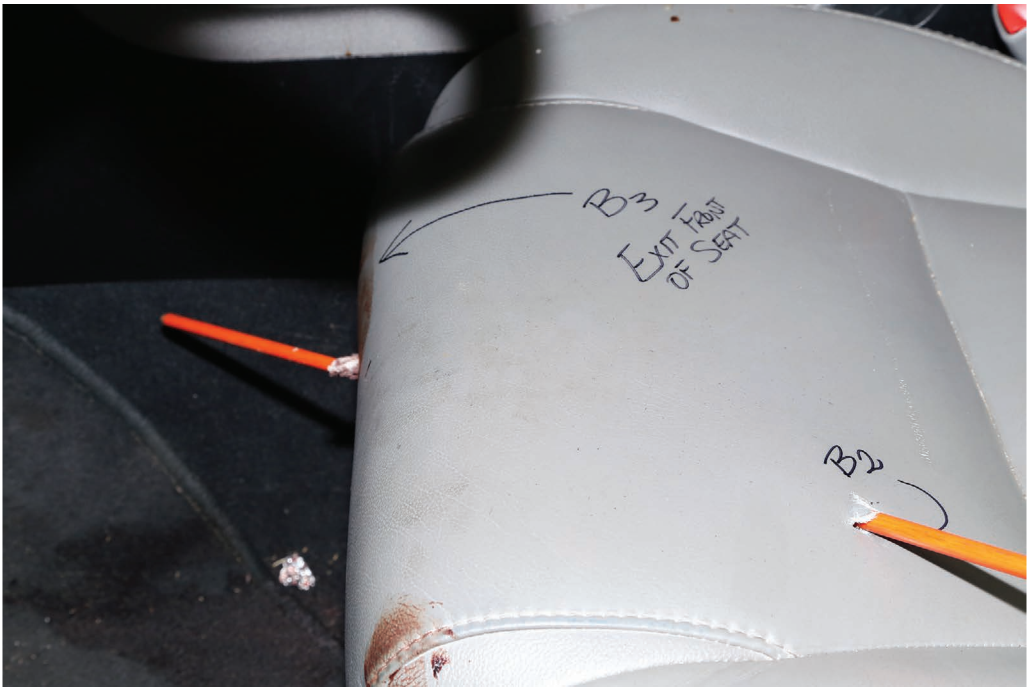


Figure 9.26 A fired bullet perforated the driver's front seat and because the fabric seats were light in color, the photograph's clarity was improved by using a permanent marker to notate the path of the fired bullet. The projectile entered at B-2 and exited out the front side of the seat at B-3.

door's outer edge. If the impact site strikes a curved portion of the vehicle, this can affect the angle calculations and curved surfaces should be made note of in the "Notes" column of the measurement's table. The impact site's height is the investigator's next concern. A yard stick or carpenter's ruler can be used to obtain an accurate height measurement. Steel tape measures are accurate, but the investigator needs to double check and ensure that the tape measure is straight and not flexing in any way. Be careful if the vehicle comes into the examination facility with a flat tire. The vehicle may have to be jacked up to a normal riding height, so that all recorded measurements are as accurate as possible.

After the lateral and horizontal measurements have all been recorded, the time has come to begin recording impact angles on the vehicle. Not every bullet strike will be suitable for an angle determination. In those cases, document the inability to record such information in one's handwritten notes and ultimately in the final written case report. Investigators should also make note of impact angles that are measured on curved, slanted, or inclined surfaces. Curved surfaces may preclude an accurate angle determination, but an inclined surface, like that of a windshield, can be measured and have the angle of the windshield or other inclined surface measured separately so that it can be subtracted from the measured incline angle, thereby giving a more accurate angle of impact. Two potential measured angles are recorded for each impact site, one horizontal and one vertical. The horizontal angle of impact is measured with a zero-edge protractor and vertical angles are recorded with an angle finder.

Vertical angles are measured using an angle finder and a trajectory rod. If the bullet hole is a perforation, in other words, if the bullet passes through two distinct surfaces, then a trajectory rod should be threaded through the two holes (Figure 9.27). Investigators can make a written note if they feel resistance during the trajectory rod's placement, which might indicate that there was some degree of bullet deflection. With the trajectory comfortably set into position, the evidence technician can place an angle finder atop the trajectory rod and record the fired projectile's vertical angle of impact (Figure 9.28). The angle finder should rest flush

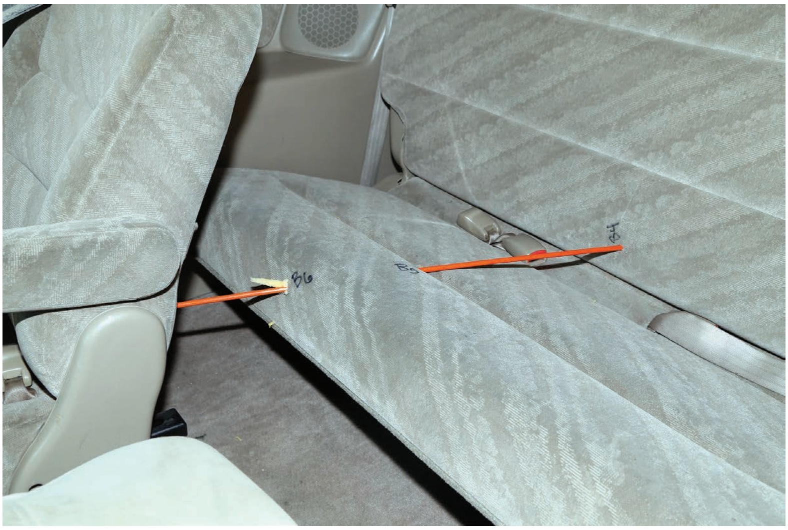


Figure 9.27 Using trajectory rods to represent the paths of fired bullets can create excellent demonstrative pieces of evidence for the courtroom. Trajectory rods come in a variety of materials. The trajectory rod present in this photograph is a "Pavement Marker" that can be purchased at any home improvement store.

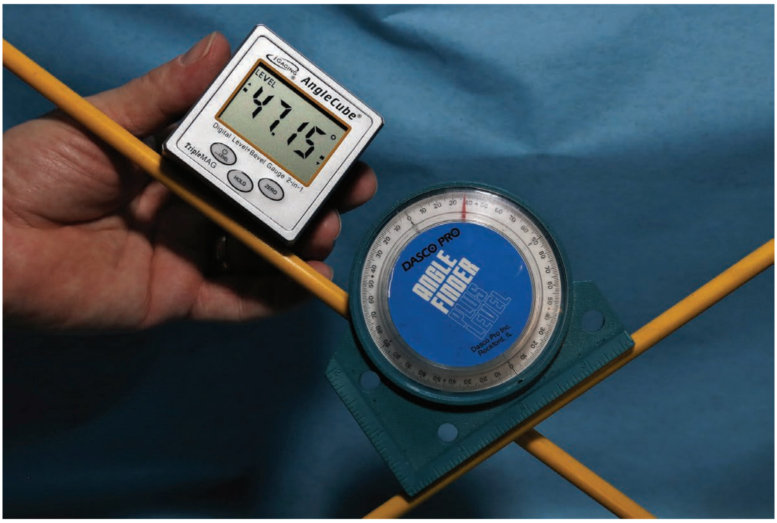


Figure 9.28 The vertical angles of impact are recorded with either an analog or a digital angle finder. The angle finder is placed flush on top of the trajectory rod to identify the fired bullet's impact angle. The benefit of the analog angle finder as seen in this image is that it is very light and does not cause the trajectory rod to flex or bend. The investigator should remember to notate whether the fired bullet was an upward or downward trajectory.

along the length of the trajectory rod. The analog or mechanical angle finders have a groove that ensures that it is flush against the trajectory rods. The digital angle finders have the added advantage of giving angle increments to a tenth of a degree. However, the reading of the angle is much more delicate because of the weight of the angle finders and their inability to balance on top of the rounded trajectory rod. In addition to the degree angles, the investigator must record whether the impact was an upward (rising) or downward (falling) angle of impact.

The horizontal impact angles are determined by placing a zero-edge protractor flush against the side of the vehicle, just below or above the trajectory rod (Figure 9.29). The protractor's base will have a 90° point in the center of the protractor. This 90° point should be aligned in the center of the trajectory rod. The investigator cannot simply record the angle at which the trajectory rod intersects with the protractor. One must look at the vehicle and calculate all angles in relation to the vehicle, with the front bumper of the

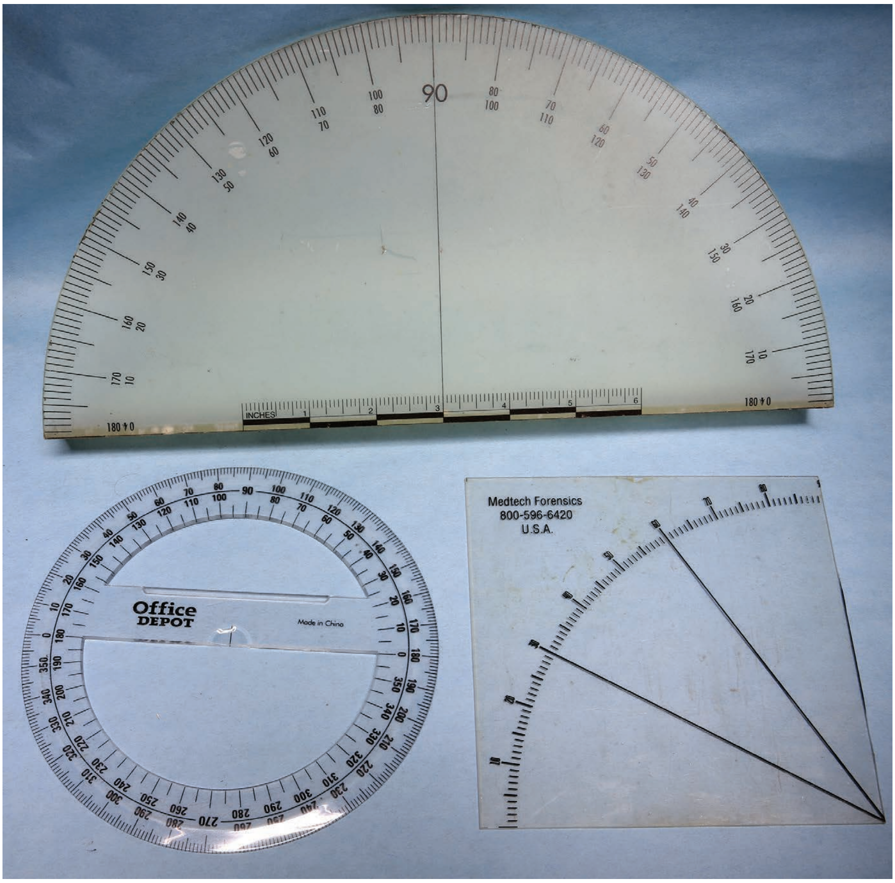


Figure 9.29 A forensic protractor is used to measure horizontal impact angles by placing the protractor flush against the side of the vehicle and aligning the protractor's 90° point directly over or under the bullet hole. A trajectory rod protruding out of the bullet hole will then lie across the angle of impact and can be recorded by investigators. A forensic protractor has a "zero-edge," which allows for a more accurate angle determination than a generic school-math protractor. The larger forensic protractor can be assisted by the smaller 90° protractor for the tighter confines of a vehicle's interior and is shown in the bottom right corner of the image. For full-vehicle trajectory assessments, a 360° protractor may offer some assistance.

vehicle looking straight forward at zero degrees (0°). Therefore, any impacts into the front of the vehicle will include measurements from from 270° to 90°. Impacts into the rear of the vehicle will also be recorded from 270° to 90° and this is why a notation of front to back or back to front is necessary in describing a fired bullet's trajectory. The right side of the vehicle will have horizontal impacts from 0° to 180°. The left side of the vehicle can be impacted from 180° to 360°. Therefore, all horizontal impact angles are recorded in relationship to the vehicle itself and not the scene unless the vehicle is being measured while still at the scene and in those cases 0° would be true north. 0° for a vehicle removed from the scene is directly forward or straight ahead of the vehicle and any angle measurements are taken clockwise around the vehicle. As a side note, the zero-edge protractors can be used to measure vertical angles as well as horizontal angles, but they are not as accurate because vehicles generally have more curves and bends to them in a bottom-to-top orientation than from a front-to-back orientation. Therefore, because the forensic protractors need a more level base on which to be placed, they are not as accurate for measuring the vertical angles of impact.

If a trajectory rod is not able to be threaded into a bullet hole because there is no second hole in which to align the trajectory rod, the horizontal impact angles can still be determined. Similar to determining a bloodstain's angle of impact, a bullet hole's angle of impact can be determined in the same manner. The investigator needs a small millimeter ruler. Millimeter increments are recommended because of their finer gradations. When examining the bullet hole, the investigator should imagine a perfect oval while measuring the length and width of the impact site. For example, one does not measure the pinch point, which is where the bullet made initial contact with the vehicle, when measuring the overall impact site's length. The width is measured at the center or widest portion of the bullet strike. With the width and the length measurements, the investigator will use a scientific calculator to determine the angle of impact. If an investigator does not have a scientific calculator handy, the calculator app on most cell phones has a scientific calculator for use. One simply needs to open up the calculator app and rotate their cell phone in a landscape orientation and the scientific calculator will appear. The formula is the same as calculating bloodstain impact angles:

- Sine of the angle = Width divided by the length (of the impact site) or Inverse Sine of the width divided by the length
- Example for a bullet strike measuring 22 mm long and 9 mm wide
  - *Formula*—Sine of the angle = 9 divided by 22
  - Sine of the angle = .4090
  - Inverse side of .4090
  - *Calculator entry*—Arc or inverse sine of .4090 (inverse sine may be achieved by pressing the "2nd" or "Inv" button prior to the sine button on one's calculator)
  - Impact angle = 24.142 or rounded to 24°

Not often, but on occasion, determining which way (from the left or the right) a fired projectile impacted the vehicle can be difficult. This is especially true on deflections and grazing impact sites. Bullets that penetrate sheet metal typically pull or roll the sheet metal in front of them and in the direction they are traveling. One can also look for the "pinch point" on painted metal surfaces, which will indicate where the bullet made initial contact with the vehicle. Pinch points are typically visible in low-angle impacts. However, if still perplexed, a bullet strike into a painted surface will cause minute fracture lines in the paint and these minute fracture lines will point *back* toward the area of origination. If the lines

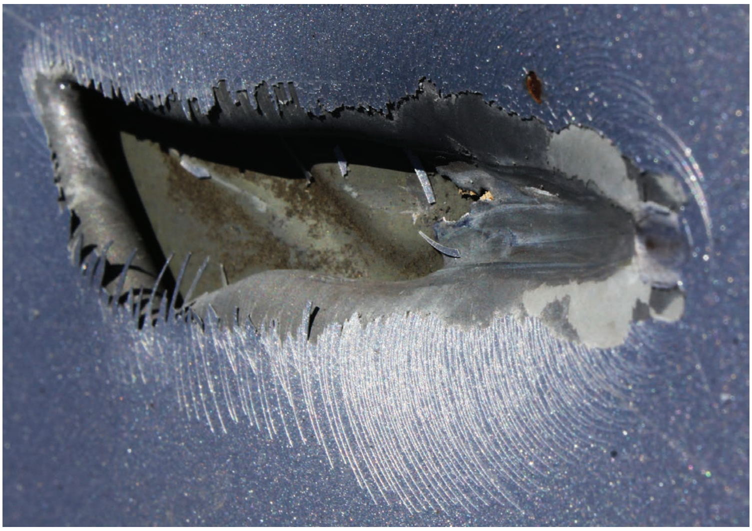


Figure 9.30 Notice the small striations that were created around the bullet strike into this car's painted sheet metal. These small striations will point back toward the area of origination. Notice how the fracture lines bend back to the right in the photograph. Consequently, the fired bullet that created this hole was traveling from right to left. Also notice the "Pinch Point" on the right side of the impact site, which indicates where the fired bullet first impacted the vehicle and the rolled sheet metal on the left side of the impact site, indicates that the projectile was traveling right to left in this image.

are not easily observed, they can be enhanced with fingerprint powder (Figure 9.30). Make sure to choose a contrasting powder with the color of the vehicle's paint and apply it over the impact site just like one would do when searching for fingerprints. The minute fracture lines will capture the powder and develop a clear indication of the fired bullet's direction of travel.

Gunpowder Residue

Gunpowder or gunshot residue is another component of ballistic evidence and something that criminal investigators will sometimes request of vehicle examiners to locate on or in a motor vehicle. Crime scene investigators are familiar with collecting gunshot residue from a suspect or their clothing. However, when a vehicle is being processed, it may be unknown where exactly and how exactly a shooting incident took place, but an evidence technician may still be requested to recover potential gunpowder residue from the vehicle. Hopefully, the case investigator will have an idea of where to search for the residue on the car based on witness statements and/or video evidence. Gunshot residue tests are primarily analyzed by a scanning electron microscope (SEM) and the gunshot residue particles are collected with a pair of round sticky disks that are approximately the size of a United States nickel. It would be impractical to search an entire vehicle for gunshot residue using just these small collection tabs.

Investigators may recover clothing from a vehicle and wish to examine it for gunpowder residue. Infrared and ultraviolet lights are frequently used to improve the visibility of soot, smoke, and gunpowder residue on targeted surfaces. Ultraviolet and infrared light will both cause soot and smoke stains found on a target surface to appear black on light-colored surfaces. Ultraviolet light has one major advantage over infrared light. Unburned particles of gunpowder that have been forced down the barrel of a firearm may actually fluoresce under ultraviolet light. Not all gunpowder will fluoresce, because the fluorescing properties are actually the coatings applied to gunpowder by some, but not all manufacturers. The coatings are designed to control the gunpowder's rate of burn. Finding these fluorescing properties is a clear indication that the firearm was in close proximity to the target when fired (Figure 9.31).

Infrared lighting is most commonly utilized for gunpowder residue imaging and is not as practical for vehicle examinations. Infrared lights and imaging systems are available, but ultraviolet lights are much less expensive and do not need any special imaging systems. Infrared light is most often used to locate gunshot residue on dark-colored surfaces. Finding such evidence can place a gun in close proximity to the vehicle and could have a huge bearing on a case. If a gunshot residue pattern happens to be located, it can help investigators determine how close a weapon was to the target and may corroborate or refute how someone claims a shooting occurred. Infrared light is the perfect platform with which to record such photographic evidence, especially when the color of the target's surface is dark or has a distracting pattern (Figure 9.32). Burned propellant absorbs infrared light and will photograph as a definitive black color. Infrared light is also likely to lighten

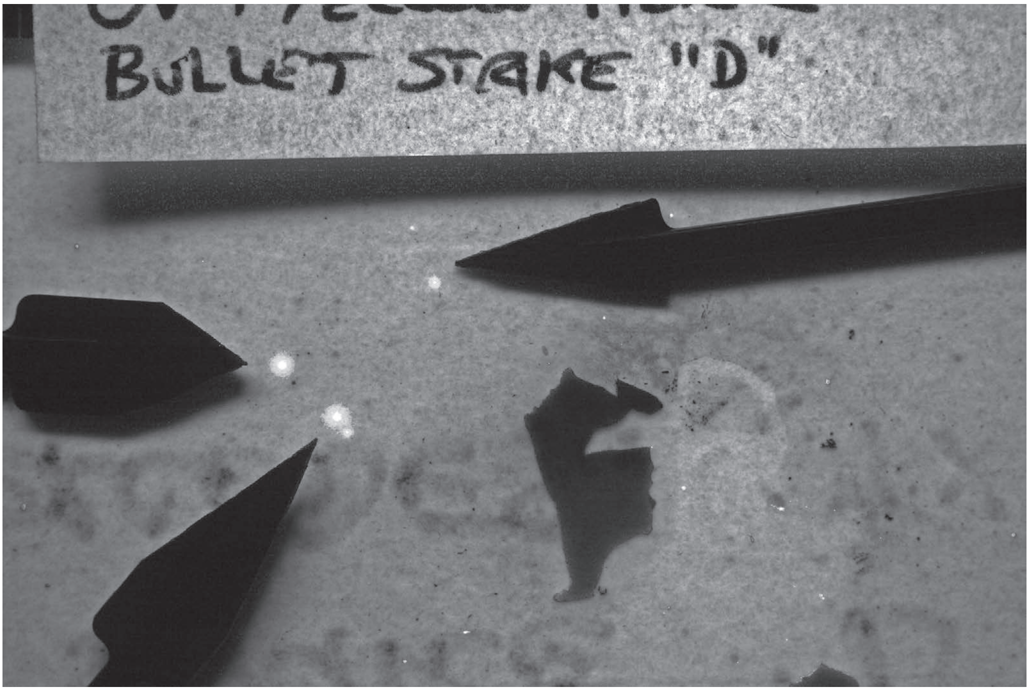


Figure 9.31 Image was recorded at ISO 100, f/11, for 15 seconds and shows the fluorescing properties of the unburned additive to gunpowder that helps control the rate of burn. These particles were tape lifted off of the exterior side of the driver's door.

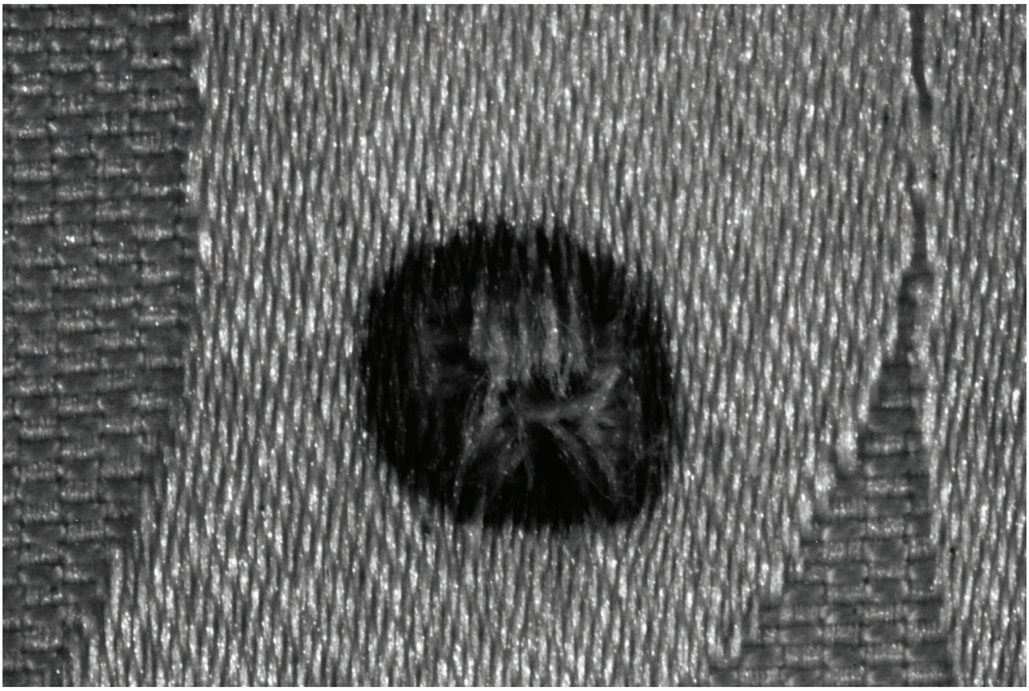


Figure 9.32 The crime scene investigator may need to photograph gunshot residue on occasion. Gunpowder residue might be in the form of powder burns and burned propellant on target surfaces. Infrared light can aid in recording these valuable pieces of evidence. This bullet hole was found on the victim's black purse and the soot ring that surrounded the hole was made visible by creating contrast via an infrared Wratten 87A filter. The camera's settings for the photograph were ISO 800, f/22, for 30 seconds.

the background, thus increasing the contrast between the gunpowder residue and the surface it rests on. Investigators using infrared light will either have to use their cameras to image possible gunpowder residue or expensive infrared imaging systems. Infrared imaging systems do allow investigators to visualize results in real time and do not have to wait for a camera's long exposures to develop.

Collection of gunshot residue is typically done with SEM collection kits. SEM is the "microscope" that will examine the collection tabs for the microscopic particles of antimony, barium, and lead. The SEM test kits have two tabs for collection purposes. The two tabs are generally for the processing of a suspect's two hands, but they can be used on small-defined areas of a vehicle. The tabs have two vial-shaped collection tabs. The plastic caps are pulled off, thereby exposing the sticky tabs. The tabs are then pressed down onto the surface being examined until the area is completely covered or more likely, until the evidence technician no longer feels any resistance from the tab's sticky surface (Figure 9.33). Depending on the size of the area being examined, the investigator may need to use more than one pair of collection tabs. These collection tabs will work on suspected clothing and small areas on a vehicle, but are not necessarily suited for a blind examination of an entire vehicle.

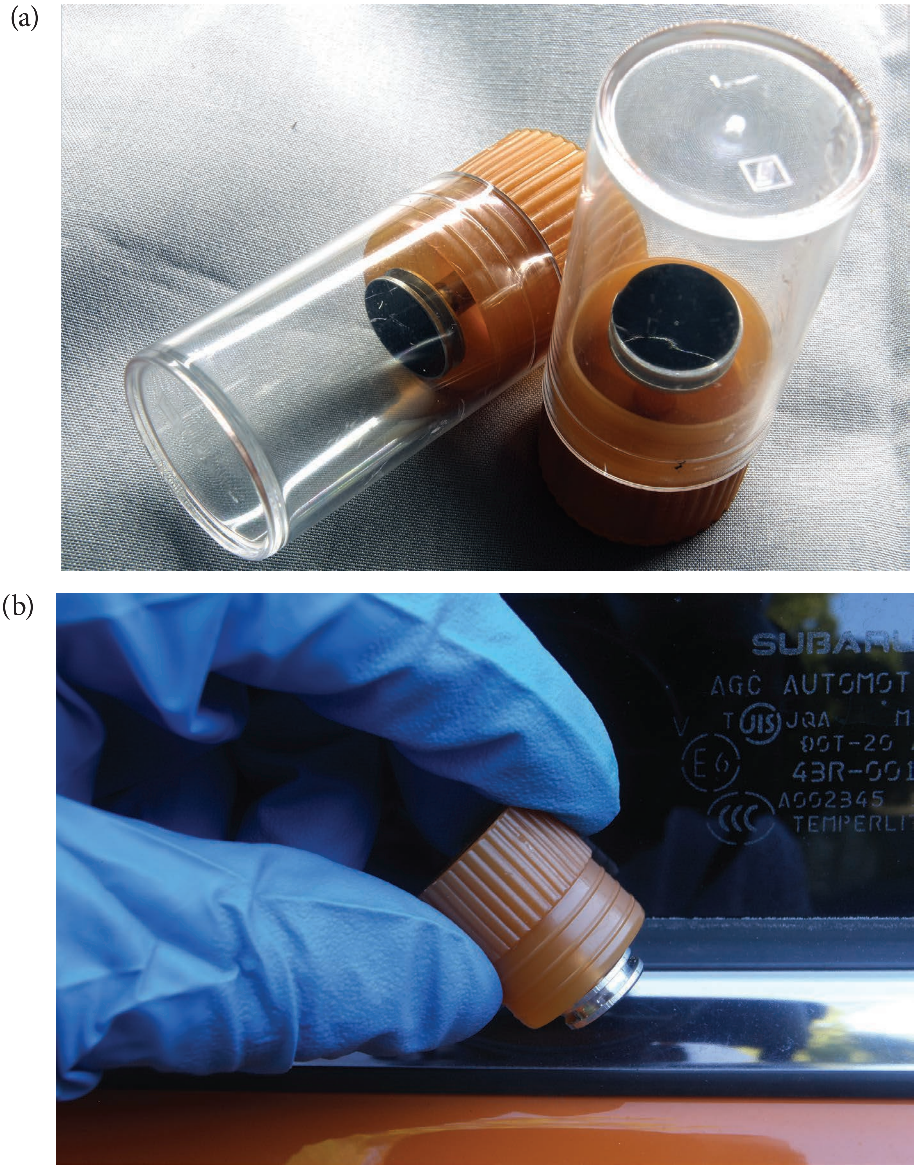


Figure 9.33 (a) A scanning electron microscope (SEM) test kit consists of a pair of sticky tabs that collect particles of barium, lead, and antimony, which are released when a gun is fired. SEM tests are typically completed on a person's hands, but they can also be used on a person's clothing, as well as a part of a vehicle where investigators believe a weapon may have been fired next to it. Image (b) shows an investigator collecting potential gunshot residue from the back-left passenger door's windowsill.

Evaluating Bullet Strikes through Glass

Vehicles have two types of window glass: tempered and laminated glass. Tempered glass is strengthened during the manufacturing process by rapidly heating and cooling the panes of glass. Tempered glass is extremely tough and when it breaks, it breaks up into thousands

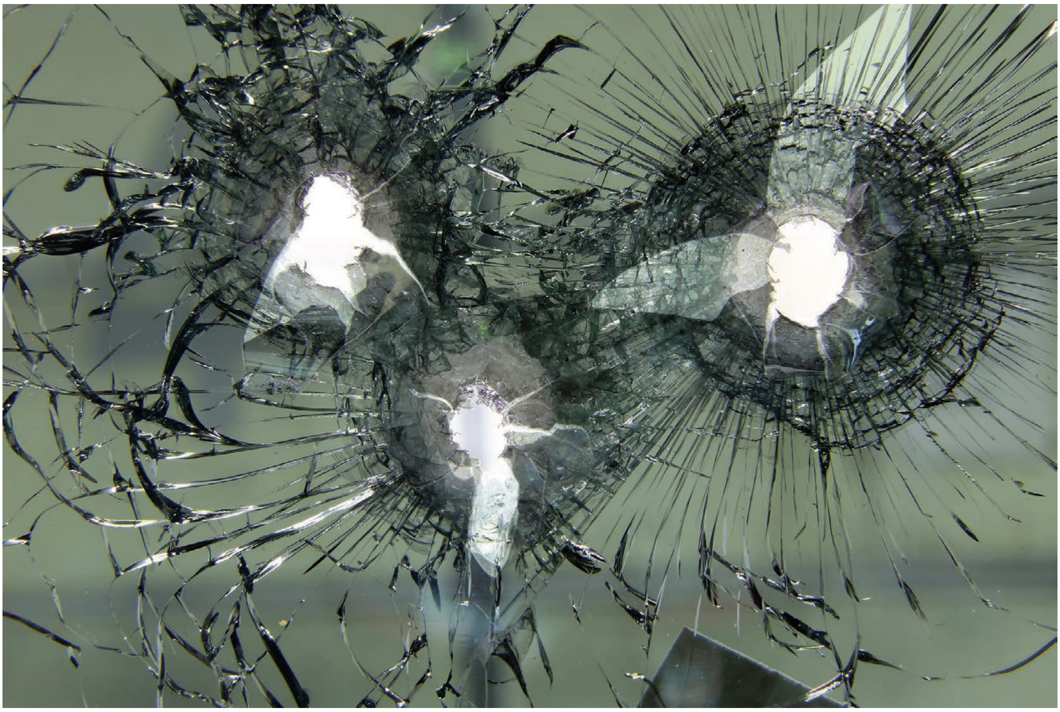


Figure 9.34 This vehicle had laminated glass mounted on the side windows of the vehicle. Three fired bullets penetrated the driver's door window, striking the driver. This photograph was recorded from inside the vehicle looking outward.

of small glass cubes. Laminated glass is manufactured with two panes of ordinary glass fused with a piece of plastic film sandwiched in between the glass panes. Tempered glass is generally found on a vehicle's side and rear windows, while laminated glass is found on the front windshield. However, do not be surprised to find laminated glass on the sides of some vehicles (Figure 9.34).

Fired bullets that perforate tempered glass generally shatter the glass and only a portion of it will remain in place. If the tempered glass has window tinting covering it, then it may hold together depending on how many bullets perforate the window (Figure 9.35). If the glass is held together and a corresponding impact site is found on the inside of the vehicle, then it may be possible to determine the horizontal and vertical impact angles. Laminated front windshields will stay in place and maintain their shape even when struck multiple times by fired projectiles (Figure 9.36). Sequencing the order of these shots is a real challenge when it comes to vehicles. When glass breaks, concentric fracture lines develop around the impact site, while radial fracture lines extend out and away from an impact site. When glass fractures, a fracture line will not cross an already existing fracture line. Consequently, one can identify which fracture line was present first and by following fracture lines back to the impact sites, one can determine which impact site was created before another. However, because windshields or laminated glass have two independent panes of glass sandwiched together, it

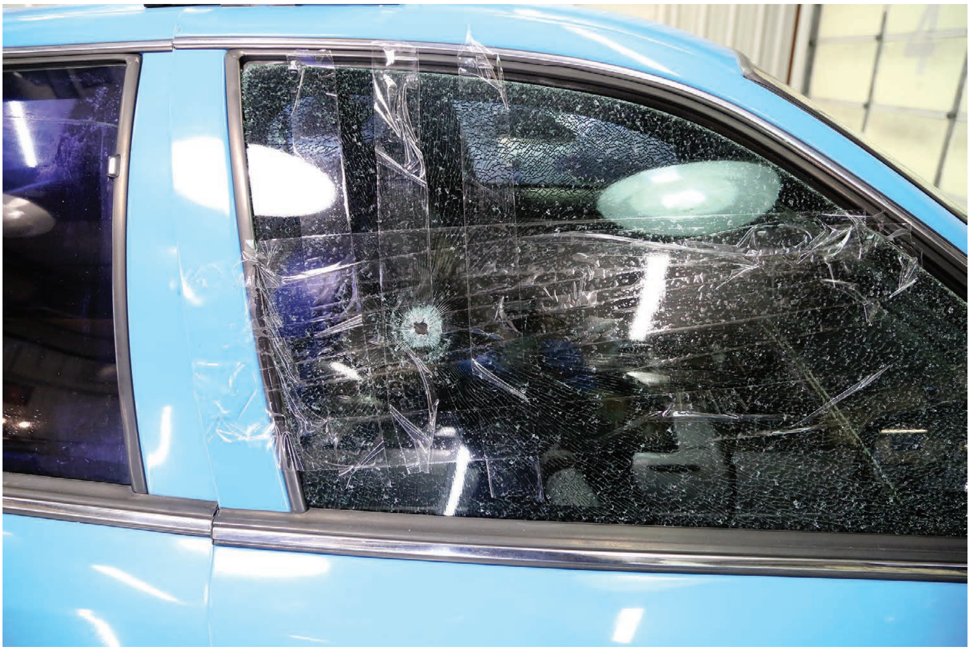


Figure 9.35 Window tinting can hold together the small cubes of tempered glass that have been shattered by fired projectiles. The glass should be taped with packing tape prior to towing to a vehicle examination facility in order to protect the integrity of what may remain on the window.

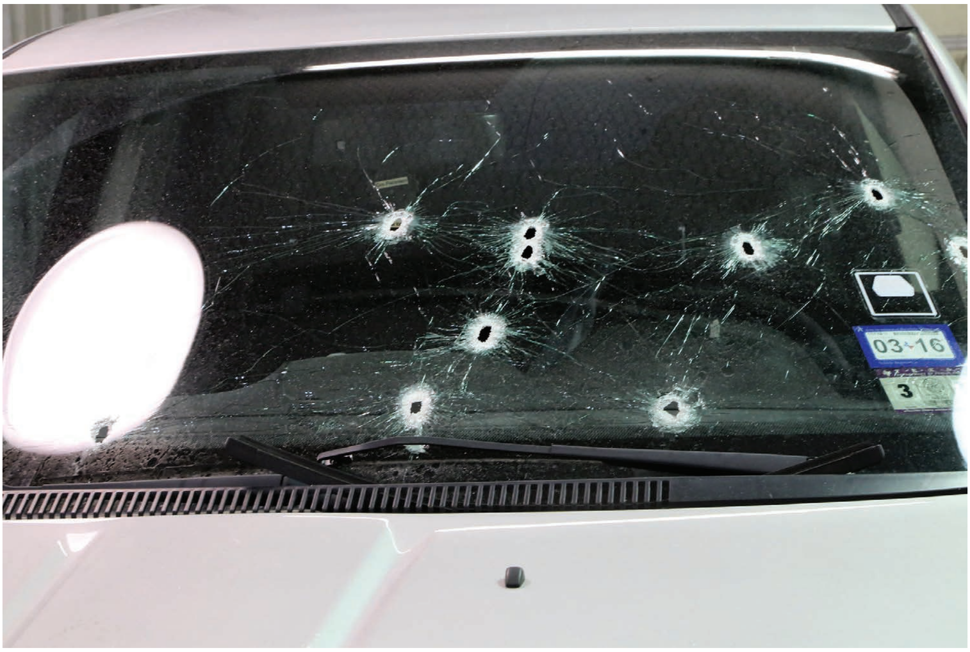


Figure 9.36 Laminated windows are extremely resilient and will maintain their integrity even when struck by multiple projectiles. This car's windshield was struck by nine fired bullets and still allowed the driver to flee the scene of the shooting.

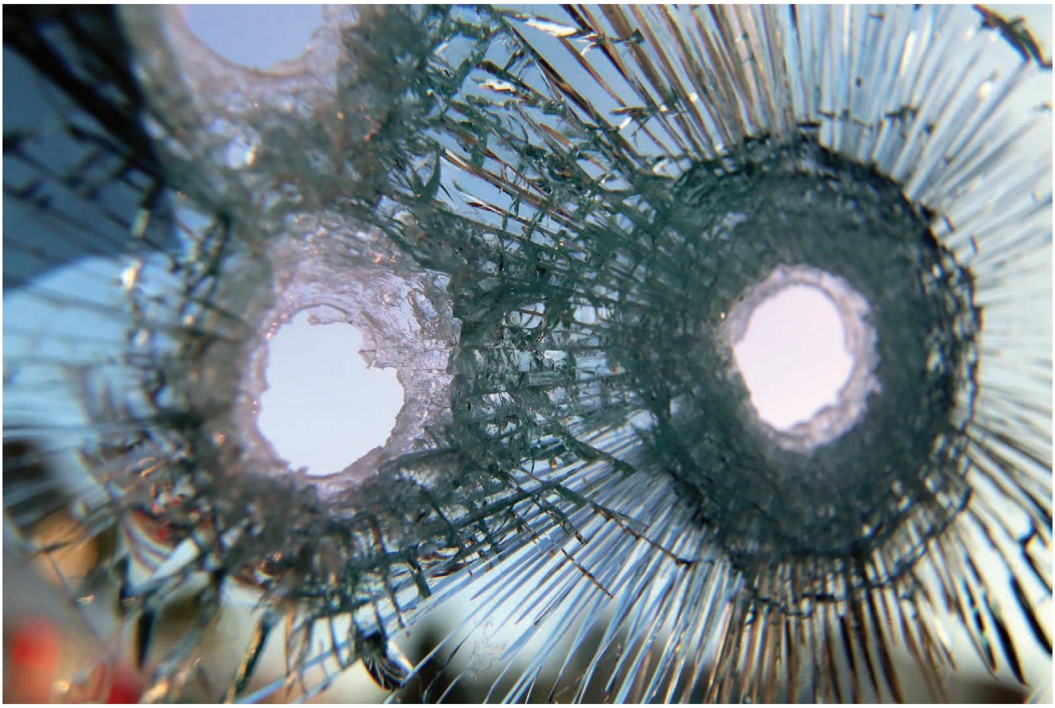


Figure 9.37 This windshield was struck by two fired bullets. Realizing that fracture lines will not cross over preexisting fracture lines, investigators can determine which bullet strike impacted first. The challenge with windshields and laminated glass is that there are two panes of glass and each has their own set of radial and concentric fracture lines. However, if the investigator can visually separate the fracture lines between the two panes of glass, then they can tell which bullet hole was created first. The bullet strike on the right side impacted first, followed by the one on the left side of the photograph. Look at the bottom of left-hand bullet hole and notice how the radial fracture lines all come to an abrupt stop along the radial fracture lines emanating from the right-side bullet hole.

is difficult, although not impossible, to visually separate the interior from the exterior fracture lines (Figure 9.37).

Many damaged vehicles that come into a vehicle examination facility are damaged because of fired projectiles entering the vehicle. However, there will be times when the case investigator wants to definitely know which way a bullet was traveling as it passed through the windshield. Determining the direction of force through windshields is done visually by inspecting the glass and using their finger to feel around the impact site. When a fired bullet penetrates the windshield, it punches a cone of glass on the exit side of the glass. The side of the glass where the fired bullet made first contact, also known as the origination side of the windshield, will have a sharp square edge at the impact point [Figure 9.38(a)]. As the bullet passes through the glass, the glass flexes and the projectile pushes a larger cone of glass away from the impact site. The exit side of the windshield will have a sloped and ragged-shaped impact site [Figure 9.38(b)].

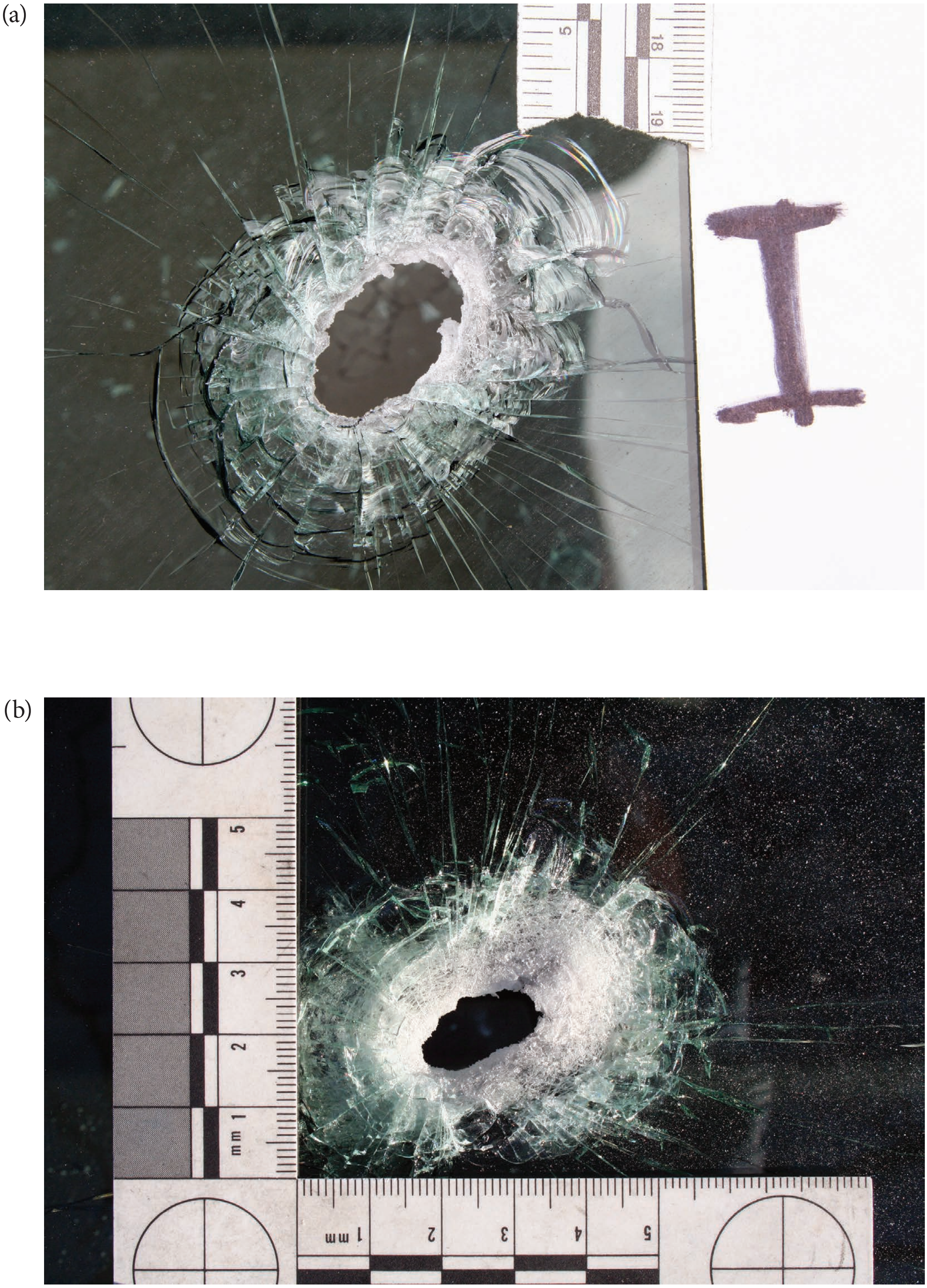


Figure 9.38 These two photographs of the same bullet strike show the sharp-squared edge on the origination side of the windshield (a) and the sloped cone-shaped edge on the exit side of the windshield (b).

Conclusion

Examining vehicles that have been struck by fired projectiles is a painstaking process of written documentation, recording multiple linear and angle measurements, and examining the vehicle so that everything is accounted for. For example, if eight bullet holes are found on a vehicle, then eight fired bullets must be accounted for inside the vehicle. Correlating all the pieces of the ballistic puzzle to tell a logical story of what happened is the vehicle examiner's goal. The vehicle examiner's job is to fully document and record all the important aspects of the vehicle. This includes all the evidence found inside and outside the vehicle. The evidence technician does not have to be a shooting reconstructionist, but they must be able to give the reconstructionist everything they need to complete their work. Speaking the same language and using commonly accepted terminology is important so that the communication between the vehicle examiner and a reconstructionist, the case investigator, and attorneys is vitally important. In addition to clear communication is the necessity to recover as much data as well, including accurate distance and angle measurements for bullet strikes and all recovered evidence. A vehicle should be treated just like any other crime scene. Thoroughness and meticulousness are the hallmarks of a quality investigator and this is especially true with vehicles involved in shootings. There is no room for shortcuts in the examination of vehicles.

Additional Readings

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Review Questions: Processing Vehicles Involved in Shootings

1. How many homicides were attributed to firearms in 2018 in the United States?
   a. 8596
   b. 10,265
   c. 12,420
   d. 14,123

2. What is the most accurate term for a firearm that has a rotating cylinder and fires a single cartridge per trigger pull?
    a. Semi-automatic pistol
    b. Pistol
    c. Revolver
    d. Handgun
3. What type of long gun has an action that is pulled to the rear and pushed forward to its firing position?
    a. Pump-action long gun
    b. Lever-action long gun
    c. Semi-automatic long gun
    d. Revolving cylinder long gun
4. What does a firearm's hammer fall on to start the ignition train that ultimately ends with the projectile pushed out of the barrel?
    a. Headstamp
    b. Primer
    c. Breach
    d. Receiver
5. Which is the most accurate term for live ammunition?
    a. Bullet
    b. Casing
    c. Charge
    d. Cartridge
6. What part of the cartridge case possesses the individualizing characteristics that a firearm's examiner can use to match a fired cartridge case to a firearm?
    a. Ejector impressions
    b. Extractor impressions
    c. Primer impressions
    d. Searing impressions
7. What pushes a projectile or bullet down the barrel of a firearm?
    a. Gas and pressure
    b. Primer and gunpowder
    c. Flash and fire
    d. Projection and propulsion
8. What is one goal mentioned in this chapter that vehicle examiners should strive to complete?
    a. Identify the suspect or perpetrator
    b. Prove the criminal investigator's theory
    c. Document and collect all evidence in as pristine condition as possible
    d. Preservation of evidence
9. The space where the identifying markings on the base of a cartridge case is located is also known as the _________________.
    a. Headstamp
    b. Primer
    c. Breach
    d. Receiver

10. When fired into a vehicle, what type of weapon can cause the most difficulty for vehicle examiners?
    a. Revolvers
    b. Bolt-action long guns
    c. Shotguns
    d. Double-action semi-automatic pistols
11. Which birdshot has the largest pellet diameters?
    a. Number 2
    b. Number 4
    c. Number 6
    d. Number 9
12. Which gauge of shotgun has the largest bore diameter?
    a. 12 gauge
    b. 16 gauge
    c. 20 gauge
    d. 28 gauge
13. Investigators should always treat each and every firearm as if it were loaded.
    a. True
    b. False
14. Where does one look on a revolver to ascertain which direction the cylinder rotates?
    a. Backside of the cylinder
    b. Small depression behind the cylinder flute
    c. On the top strap
    d. Behind the hammer
15. What hidden location on a pistol may hold DNA evidence from the shooter, even if the weapon had been wiped down?
    a. Inside the magazine well
    b. Inside the receiver
    c. Behind the grips
    d. Inside the barrel
16. Fingerprints are more likely recovered from a firearm's pistol than DNA evidence.
    a. True
    b. False
17. What should be done prior to cyanoacrylate fuming any firearms?
    a. The gun should be disassembled
    b. The ammunition should be placed into the fuming chamber together
    c. Tape should be placed over both ends of the barrel
    d. The weapon should be test fired before fuming
18. Which of the following is NOT one of the shapes that can develop when fired bullets pass through the softer material of a vehicle's interior?
    a. Round
    b. Oval
    c. Cut or slit
    d. None, all these shapes can develop from a fired bullet

19. What tool can be used to help locate a fired bullet inside the foam of a vehicle's upholstered seats?
    a. Screwdriver
    b. Reciprocating saw
    c. Metal detector
    d. Wet–dry vacuum
20. What tool can be used to help locate a fired bullet from inside a car door's frame?
    a. Screwdriver
    b. Reciprocating saw
    c. Metal detector
    d. Wet–dry vacuum
21. Which type of bullet is more likely to shatter into numerous pieces upon striking an automobile because of its higher velocity?
    a. .22 caliber hardnose bullet
    b. 7.62 × 39 mm high-velocity rifle round
    c. .38 caliber hollow point
    d. Shotgun's slug round
22. What feature on a car may cause an impact angle determination to be erroneous?
    a. Direction the car is facing
    b. Curved surfaces on the car
    c. Color of the painted surfaces
    d. Tinted windows
23. What should an investigator name the spot where a projectile struck a car's door?
    a. Impact site
    b. Bullet defect
    c. Bullet strike
    d. Any of the above
24. Which horizontal angle of impact initially struck the exterior side of the driver's side door?
    a. 48°
    b. 129°
    c. 178°
    d. 224°
25. What is the formula for determining the angle of impact from a bullet hole?
    a. Sine of the angle = width/length
    b. Inverse sine of the angle = width/length
    c. Sine of the angle = length/width
    d. Inverse sine of the angle = length/width
26. When a bullet strikes the painted surface of a vehicle, it creates minute fracture lines. Which way do these fracture lines point?
    a. They point toward the target
    b. They are equal to the trajectory angle
    c. They point back toward the shooter
    d. They have no meaning

27. What kind of light is used to visualize gunpowder residue more easily?
    a. Ultraviolet light
    b. Infrared light
    c. Ultraviolet and Infrared light
    d. Light between 550 and 650 nm
28. What type of microscope is used to image individual particles of gunpowder residue?
    a. Comparison microscope
    b. Scanning electron microscope
    c. Compound microscope
    d. Stereomicroscope
29. What is the shape of an impact site found on the entrance side of a vehicle's windshield?
    a. Sloped cone shape
    b. Oval shape
    c. Sharp-squared shape
    d. Circular shape
30. What is the shape of an impact site found on the exit side of a vehicle's windshield?
    a. Sloped cone shape
    b. Oval shape
    c. Sharp-squared shape
    d. Circular shape

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Bloodstain Documentation and Processing

10

Processing vehicles involved in violent crimes often requires the vehicle's examiner to wade through a river of blood and guts. When a human body is perforated by numerous fired bullets, the aftermath is not a pretty sight. If an evidence technician is faced with a vehicle "covered in blood," the task of documentation and eventual analysis of that blood can be critical to an investigation. Bloodstain pattern analysis is a field that requires a significant amount of specialized training and it is recommended that one has a board certification like the one offered by the International Association for Identification (IAI). The IAI is the oldest and largest professional organization of forensic practitioners in the world. However, even if an evidence technician is not capable of interpreting bloodstain patterns, they can document the bloodstain evidence with confidence. If the documentation of bloodstain evidence is competently completed, then a bloodstain pattern analyst can use that documentation and possibly give an interpretation or meaning to the bloodstains found on the vehicle.

Remember that an investigator's written reports are to be written from their observations and discovered facts. Bloodstain pattern interpretation is a higher level of report, offering expert opinions. In the course of processing a vehicle, an evidence technician is likely to produce a more valuable report if they understand the basics of how blood is deposited onto a surface. A simple understanding of bloodstain dynamics can help an investigator recognize the physical characteristics of a bloodstain, which can provide an idea of a bloodstain's mechanism of creation, directionality, and area of origination. At the very least, communicating the investigator's observations is a priority and so that the communication is clear, the investigator should have an understanding of the accepted terminology in the field of bloodstain pattern analysis. Ever since the 2009 National Academy of Sciences report, entitled "Strengthening Forensic Science in the United States: A Path Forward," the forensic science community has been striving to improve all the forensic science disciplines, including bloodstain pattern analysis. Currently, the National Institute of Standards and Technology (NIST) oversees the "Organization of Scientific Area Committees for Forensic Science" or OSAC for short. The OSAC is separated into five Scientific Area Committees:

- Physics/Pattern Interpretation
- Crime Scene/Death Investigation
- Digital/Multimedia
- Biology/DNA
- Chemistry/Instrumental Analysis

Bloodstain Pattern Analysis falls under the Physics/Pattern Interpretation subcommittee, which also includes these five subcommittees:

- Bloodstain Pattern Analysis
- Firearms and Toolmarks
- Footwear and Tirewear

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- Forensic Document Examination
- Friction Ridge (Fingerprints)

These committees and subcommittees are trying to provide investigators and scientists with a base set of protocols and procedures to assist them in performing their duties. The bloodstain subcommittee has currently released the following 12 documents regarding the science of bloodstain pattern analysis, and they are working on a number of others:

- Standard for Quality Assurance Program in Bloodstain Pattern Analysis (2019)
- Standards for Report Writing in Bloodstain Pattern Analysis (2020)
- Standards for a Bloodstain Analyst's Training Program (2020)
- Terms and Definitions in Bloodstain Pattern Analysis (2017)
- Standard for the Validation of Procedures in Bloodstain Pattern Analysis (2019)
- Bloodstain Pattern Process Map (2019)
- Bloodstain Pattern Analysis Bibliography (2019)
- Research and Development Needs identified by the Bloodstain Pattern Analysis Subcommittee
- Educational Model for Introductory Bloodstain Pattern Analysis Training
- Guidelines for Proficiency Testing in Bloodstain Pattern Analysis
- Guidelines for Developing Standard Operating Procedures for Bloodstain Pattern Analysis
- *Appendix A*—SOP Guidelines Section 3: Equipment, Materials, and Reagents

Anyone can access these standards and documents through the Organization of Scientific Area Committees for Forensic Science page on the www.nist.gov website.

Basics of Bloodstain Pattern Analysis

To begin with, the information that follows will **not** make a reader qualified to be a bloodstain pattern analyst. Working as a bloodstain pattern analyst requires extensive reading of books dedicated to the field of bloodstain pattern analysis, bloodstain training, conducting bloodstain experiments, and working in the field. However, bloodstain pattern analysts do appreciate quality scene documentation and can work with an investigator who can communicate intelligently about what they saw on a vehicle. That communication is transmitted through quality photographs and intelligent writing. Being able to communicate involves speaking the same language and that means using the terminology approved by the bloodstain OSAC. To begin with, investigators should never use the word "splatter" in their reports. The correct term is "spatter," but analysts are not bloodspatter analysts. Bloodspatter is just one part of the entire science of bloodstain pattern analysis. The importance of using the correct terminology was stated best by the OSAC on bloodstain pattern analysis in their 2017 Terms and Definitions of Bloodstain Pattern Analysis:

> This document provides a list of recommended terms and definitions to be used in published manuscripts, forensic reports discussing the conclusions of scientific examination of bloodstains, in courtroom testimony, and when teaching bloodstain pattern analysis. The target audience of this document includes crime scene investigators, forensic scientists, investigators, attorneys, judges, and researchers.

The list of approved terminology will be detailed below and although it is feasible that every stain and stain pattern may present itself inside of a vehicle, the smaller confines of the vehicle do limit some stain patterns from occurring, such as cast-off stains. Of course, cast-off stain patterns are always possible on the exterior of a vehicle's surface.

- *Accompanying Drop*—A small blood drop produced as a by-product of drop formation (Figure 10.1).
- *Altered Stain*—A bloodstain with characteristics that indicate a physical change has occurred (Figure 10.2).

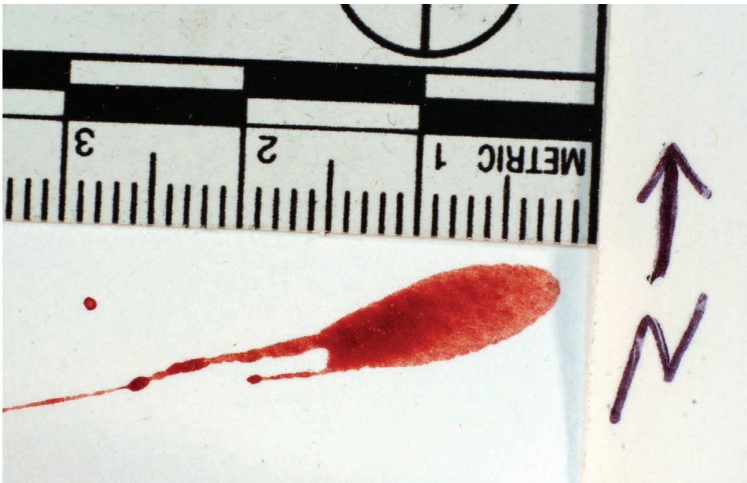


Figure 10.1 The Accompanying Drop is formed independently when the droplet of blood breaks away from the source of blood and not because of the droplet's impact on the surface. As a result, accompanying blood drop stains cannot be linked to a spine or a scalloped edge characteristic. They tend to stand alone next to the independent bloodstain.

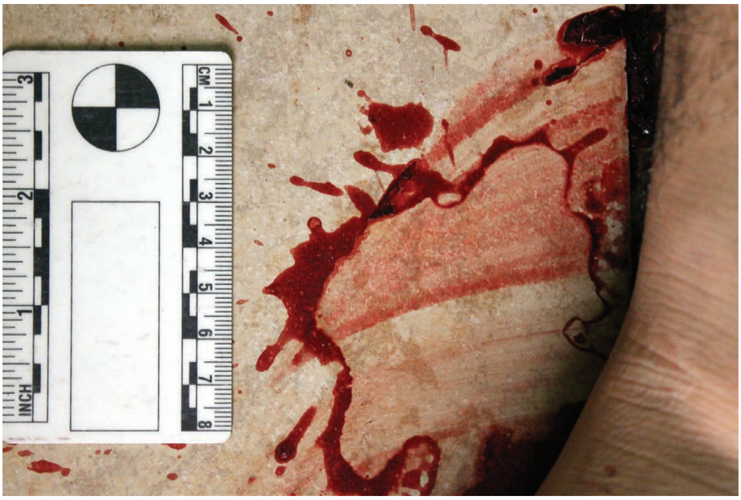


Figure 10.2 A bloodstain that has been deposited and changed in some way by another force is known as an Altered Stain. This photograph depicts a bloodstain that was disturbed by the arm moving through the bloodstain. The originally deposited bloodstain is the altered stain and the bloodstain pattern that shows motion is known as a wipe pattern. To confuse things a little more, the outer portion of the original stain that remains on the floor is known as a perimeter stain. Therefore, in this one picture, an investigator might identify the altered stain, wipe pattern, and perimeter stain.

- *Angle of Impact*—The angle (alpha), relative to the plane of a target, at which a blood drop strikes the target (Figure 10.3).

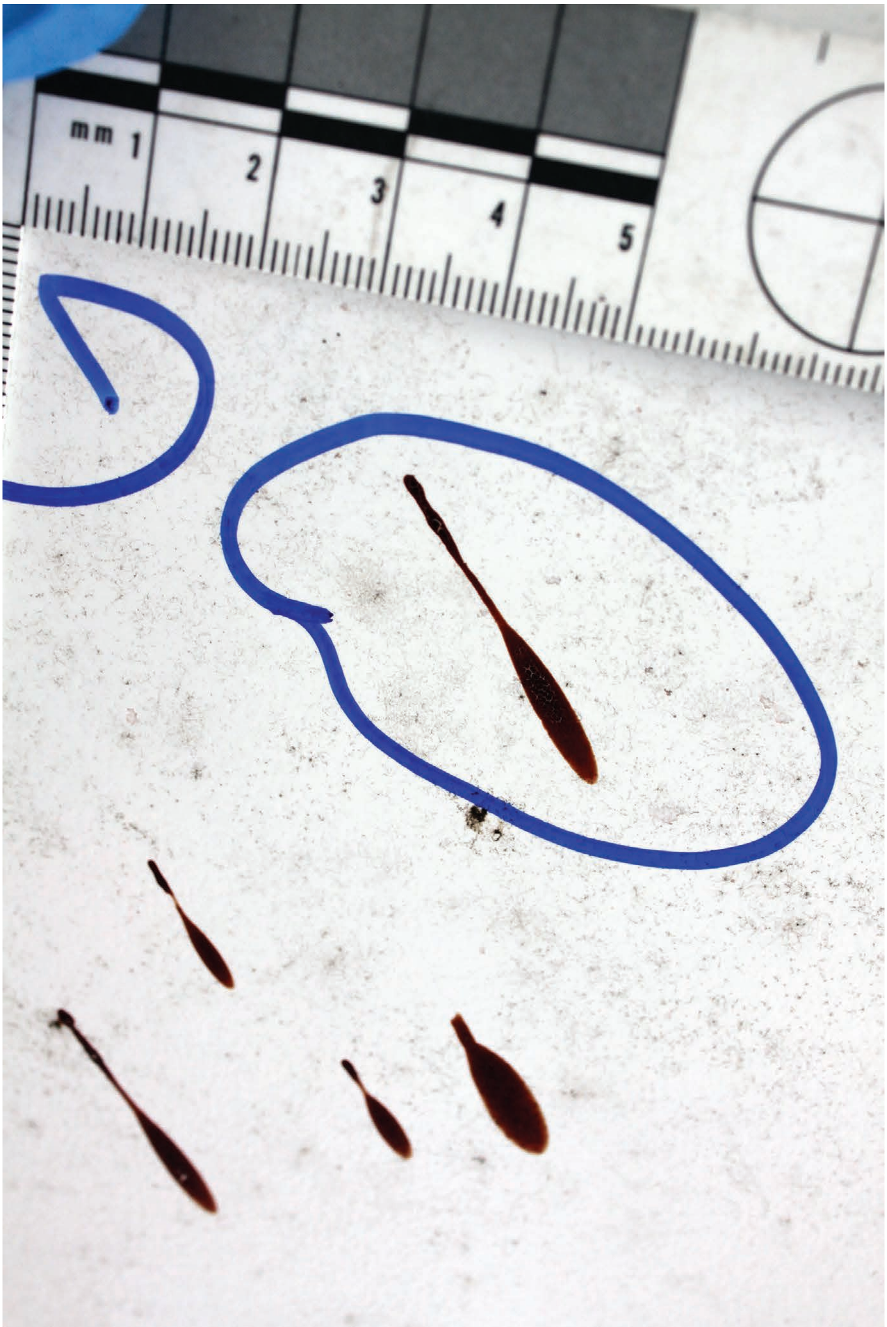


Figure 10.3 The bloodstain's Angle of Impact onto a target can be calculated by the relationship between the width and the length of a bloodstain. The difficult part of measuring is to envision a perfect ellipse and not include any edge characteristics, like the long spine extending off the bloodstain circled in this photograph.

- *Area of Convergence*—The space in two dimensions to which the directionalities of spatter stains can be retraced to determine the location of the spatter-producing event (Figure 10.4).
- *Area of Origin*—The space in three dimensions to which the trajectories of spatter can be utilized to determine the location of the spatter-producing event (Figure 10.5).
- *Backspatter Pattern*—A bloodstain pattern resulting from blood drops, which can be produced when a projectile creates an entrance wound (Figure 10.6).

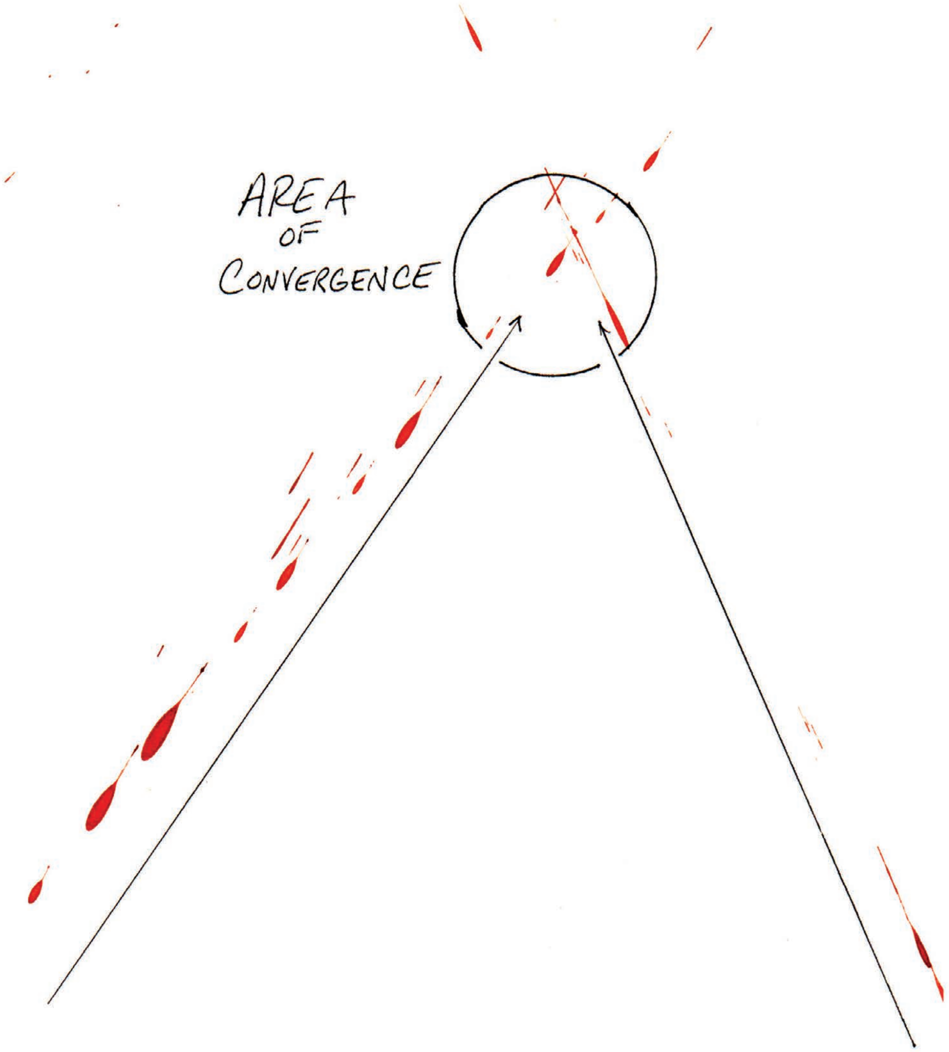


Figure 10.4 The Area of Convergence is found on a single plane, by finding the point or area where two bloodstains or bloodstain patterns intersect. If the two stains do not intersect as cleanly as the ones visible in this image, the investigator can continue the direction of travel by drawing a line through the long axis of the bloodstain(s) in order to show its forward direction of travel. The area of convergence and the individual bloodstain's angle of impact are used to determine the area of origin.

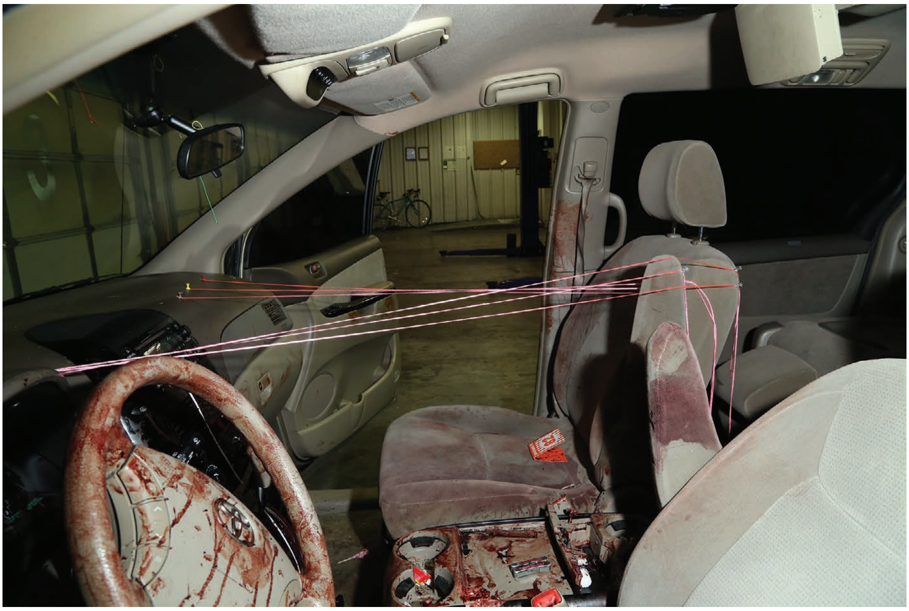


Figure 10.5 The Area of Origin is determined by multiplying the Tangent of the stain's Impact Angle and multiplying it by the distance found in the area of convergence. In this photograph, the elongated ellipses found on the vehicle's dashboard helped corroborate the fact the victim's head was down and away from the passenger's side door when they were shot.

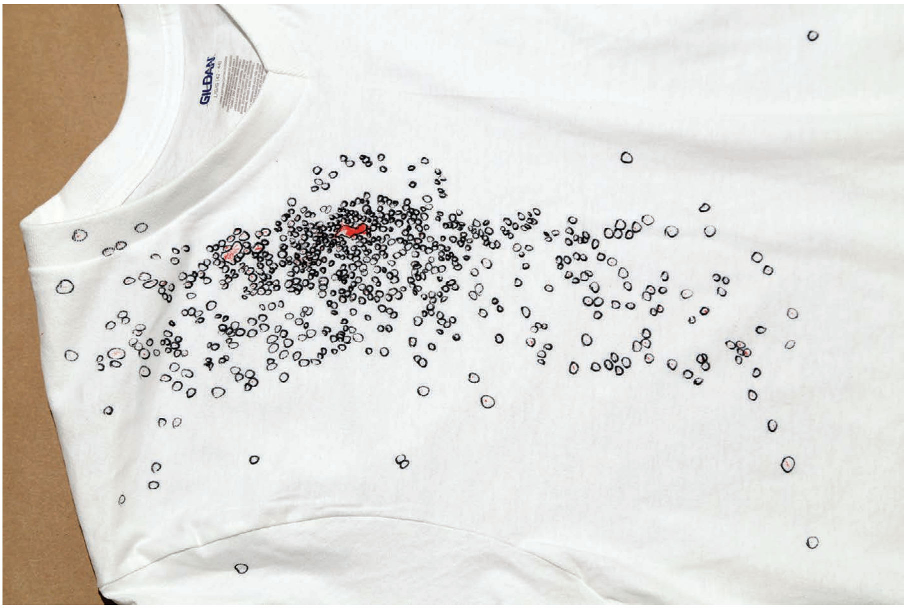


Figure 10.6 Backspatter is produced from the creation of a gunshot wound or other high-dynamic event. The shirt in this photograph was worn by a right-handed shooter. Because gunfire creates a tremendous amount of energy, the resulting bloodstains can be extremely small. To assist the viewer in seeing the bloodstains, each stain was circled with a black permanent marker. Add in the fact that backspatter produces fewer stains than forward spatter, the discovery and photography of the stains require a close examination.

- *Blood Clot*—A gelatinous mass formed by a complex mechanism involving red blood cells, fibrinogen, platelets, and other clotting factors (Figure 10.7).
- *Bloodstain*—A deposit of blood on a surface (Figure 10.8).

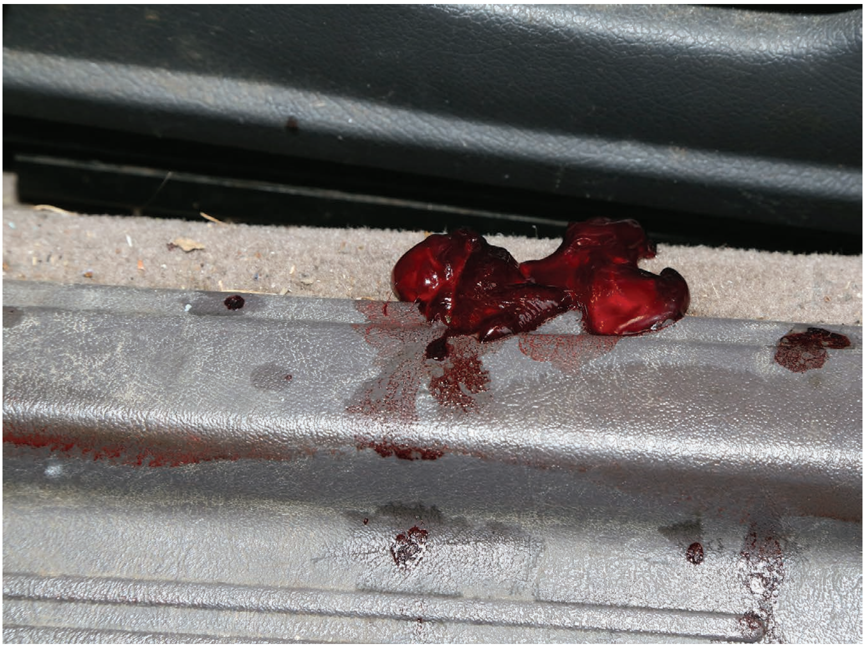


Figure 10.7 Blood Clots are more likely to form during more severe wounds, such as the fatal gunshot wound suffered by the victim in this vehicle.

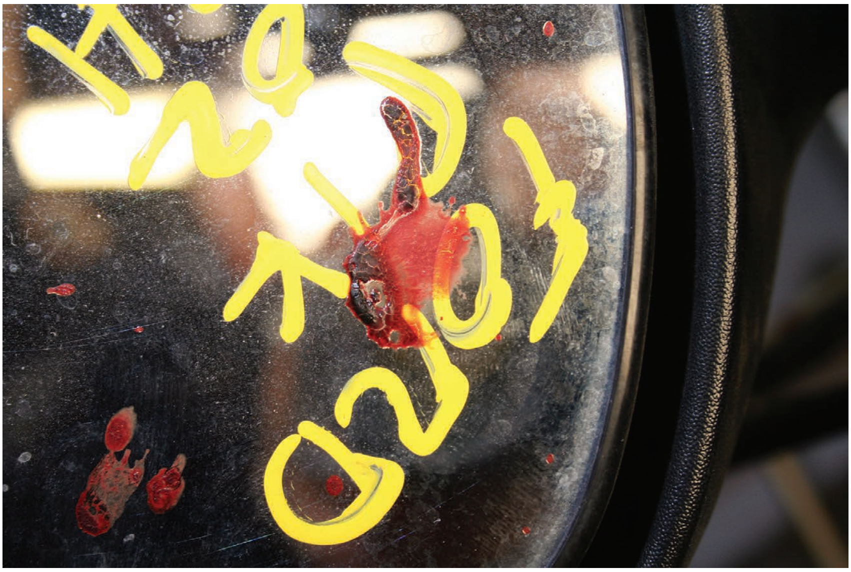


Figure 10.8 Any single drop of blood is considered a Bloodstain. The proper terminology for a drop of blood on a Target (surface) is "bloodstain." It is not bloodspatter or even worse, bloodsplatter. Bloodspatter has a very specific meaning involving a force being applied to a blood source.

- *Bloodstain Pattern*—A grouping or distribution of bloodstains that indicates through regular or repetitive form, order, or arrangement how the pattern was deposited (Figure 10.9).
- *Bubble Ring*—An outline within a bloodstain resulting from air in the blood (Figure 10.10).

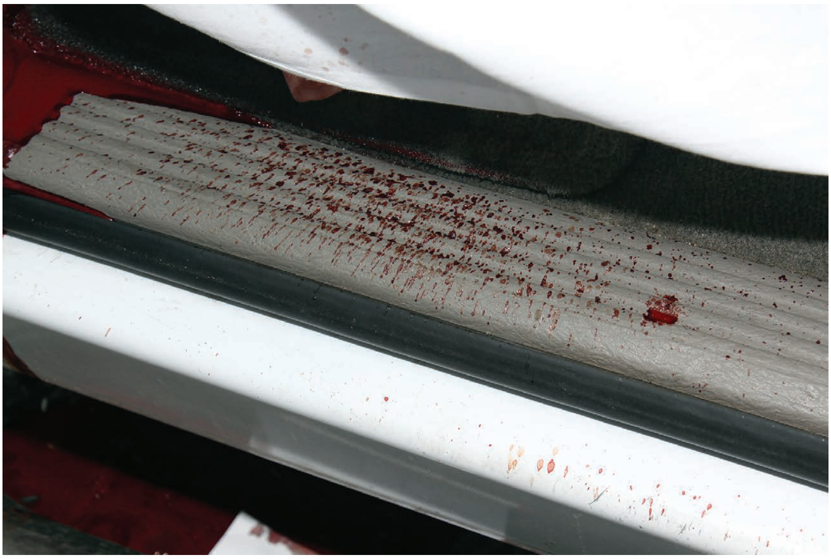


Figure 10.9 A Bloodstain Pattern differs from a simple bloodstain because it requires more than a single stain and likely exhibits information about how it was deposited onto the surface. The bloodstain pattern created in this picture came from a severed femoral artery and the blood seeped through the victim's pants, cascaded over the driver's seat, and onto the truck door's threshold.

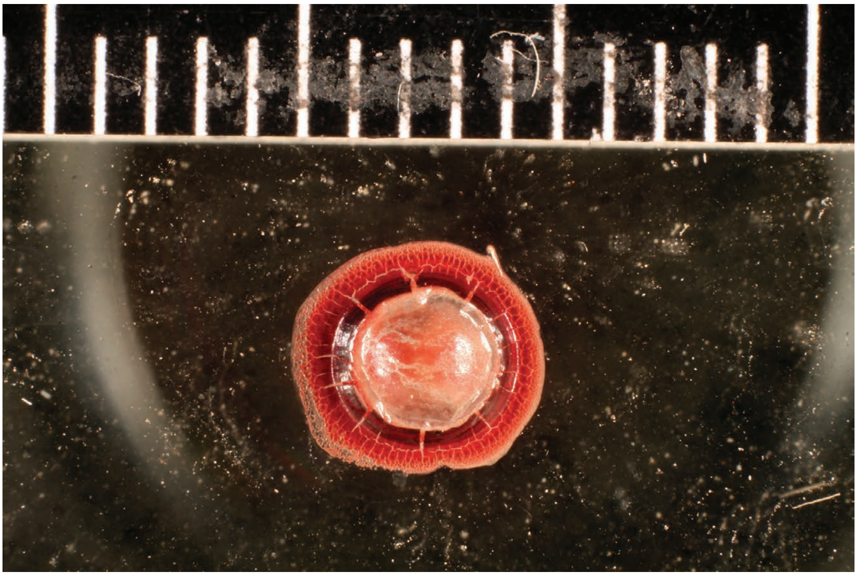


Figure 10.10 This bloodstain was found on a car's interior rearview mirror and was created when the victim was shot through the lungs and coughed up blood across the front of the vehicle.

- *Cast-off Pattern*—A bloodstain pattern resulting from blood drops released from an object due to its motion (Figure 10.11).
- *Cessation Pattern*—A bloodstain pattern resulting from blood drops released from an object due to its abrupt deceleration (Figure 10.12).

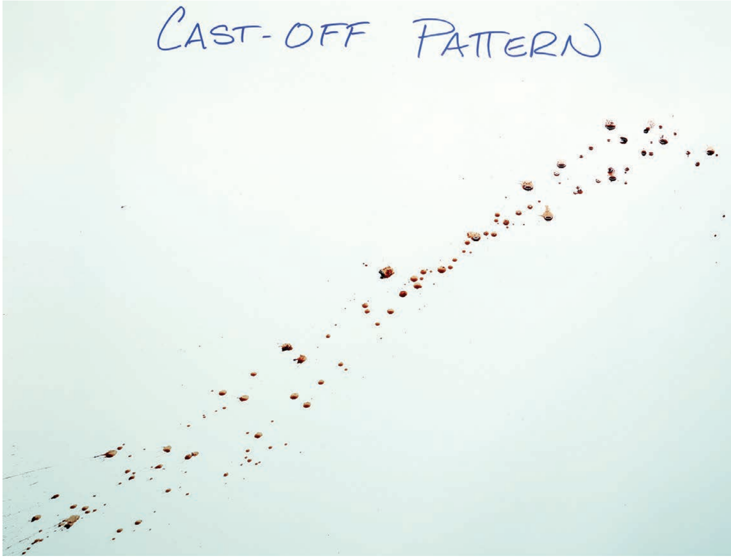


Figure 10.11 Cast-off Patterns and cessation patterns are not commonly found on the inside of a vehicle because there is generally not enough room inside a vehicle to be swinging a weapon. However, one may still find such patterns on the outside of a vehicle.

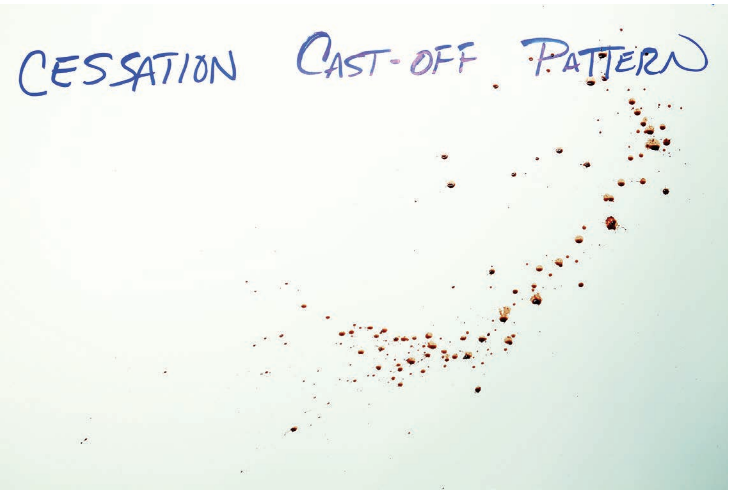


Figure 10.12 Cessation Patterns occur when a suspect is swinging a blood-soaked object, but the motion of the object (weapon) is abruptly halted causing the blood to fly off the weapon all at once. Notice the difference between a cast-off pattern depicted in Figure 10.11 and the cessation pattern in this figure. The individual stains found in the cast-off pattern are aligned in a much more linear pattern, while in the cessation pattern, the individual bloodstains are oriented together in a more non-descript clustering pattern. Just to note, the same weapon (1"-wide pipe) created both patterns with a similar volume of blood placed on the pipe.

- *Directionality*—The characteristic of a bloodstain that indicates the direction blood was moving at the time of deposition (Figure 10.13).
- *Directional Angle*—The angle (gamma) between the long axis of a spatter stain and a defined reference line on the target (Figure 10.14).

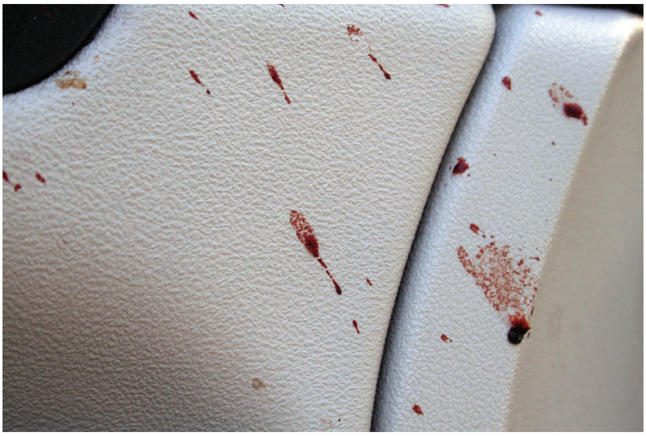


Figure 10.13 Elliptical-shaped bloodstains will have impacted a surface at an angle. The blood drop is determined by identifying the leading edge of the stain, which has the edge characteristics like scalloped edges or elongated spines, like in this photograph. The elongated stains in this photograph are traveling in a down and to the right Direction.

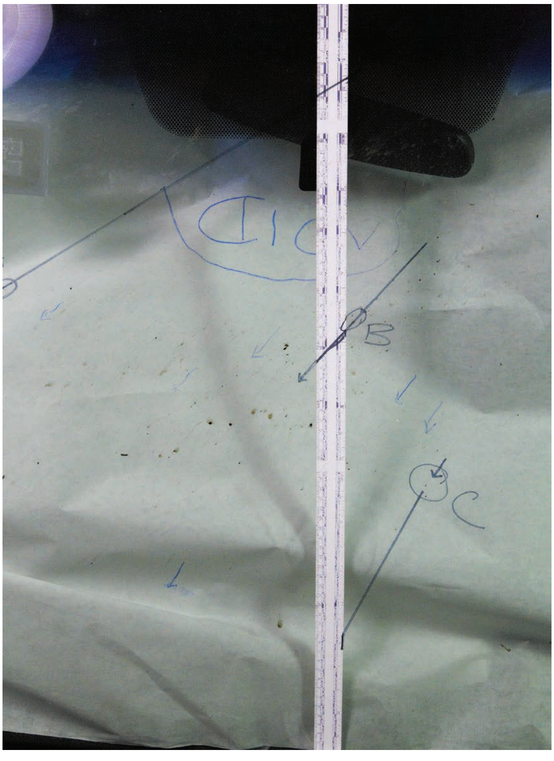


Figure 10.14 The bloodstains that struck this windshield struck in a down and to the left Direction. The scale tape running down the middle of the photograph was used as a plumb or center line in the window.

- *Drip Pattern*—A bloodstain pattern resulting from a liquid that dripped into another liquid, at least one of which was blood (Figure 10.15).
- *Drip Stain*—A bloodstain resulting from a falling drop that formed due to gravity (Figure 10.16).

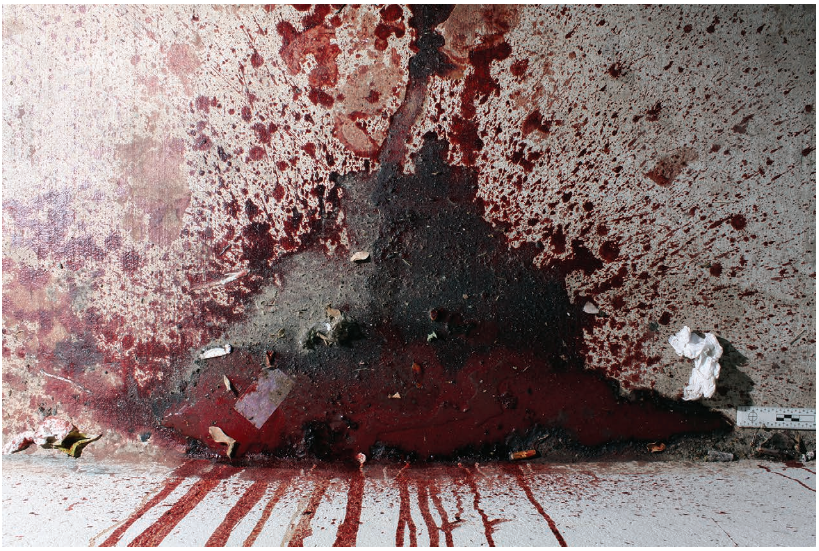


Figure 10.15 A Drip Pattern is found most often from blood dripping into blood. When blood impacts a pre-formed pool of blood, the blood is broken up into smaller droplets and cast outward, creating numerous satellite stains all around the periphery of the pool of blood.

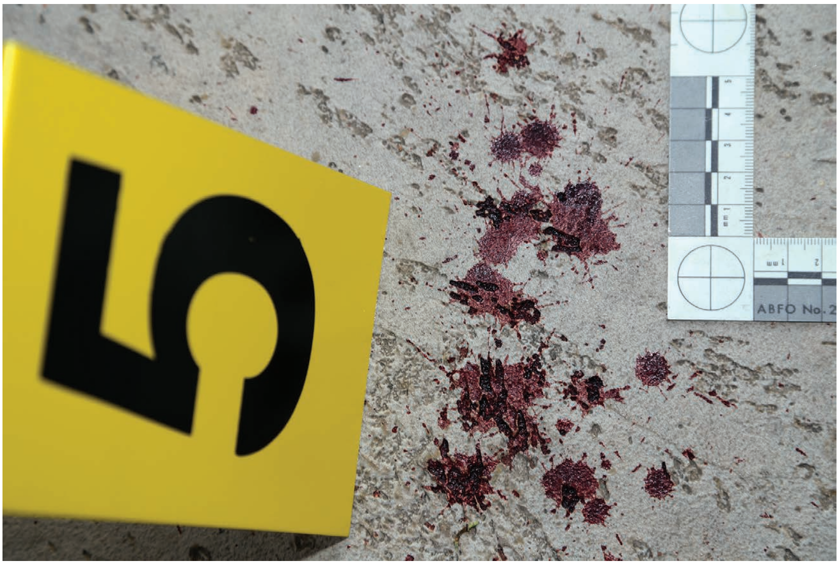


Figure 10.16 Drip Stains are created by free-flowing blood that falls due to gravity and no other force or energy. The stains are generally round, although stains landing on the curved or vertical surfaces of a vehicle may appear elliptical.

- *Drip Trail*—A bloodstain pattern resulting from the movement of a source of drip stains between two points (Figure 10.17).
- *Edge Characteristic*—A physical feature of the periphery of a bloodstain (Figure 10.18).

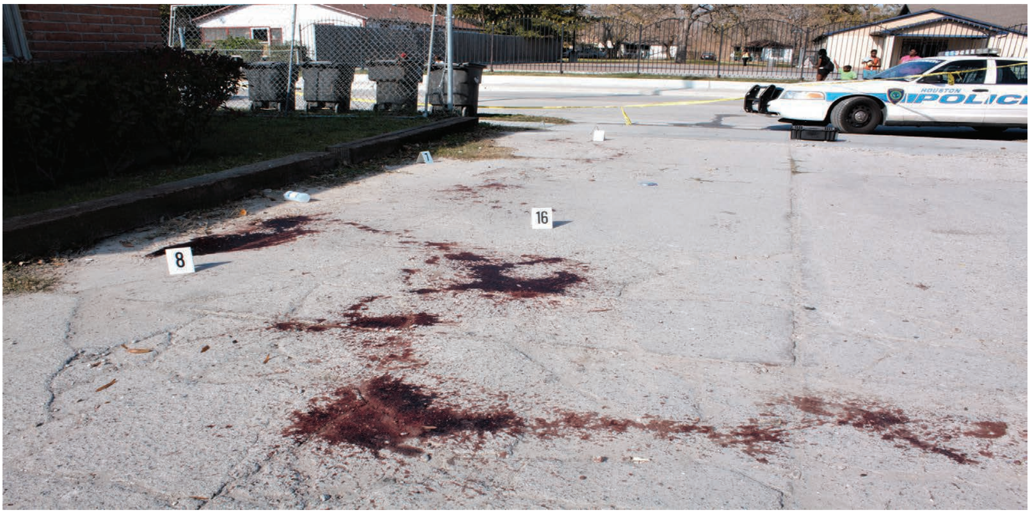


Figure 10.17 A Drip Trail is created by a sequence of falling blood drops due to gravity by a moving blood source. These stains are generally round in shape, but will have edge characteristics that develop on the leading edge of the stain that can indicate the direction of travel and may even elongate as the speed of the movement increases. In this photograph, the victim was shot near the street and traveled away from the street, leaving behind a blood trail. One can even see where the victim paused while retreating from the roadway from the concentrated areas of blood.

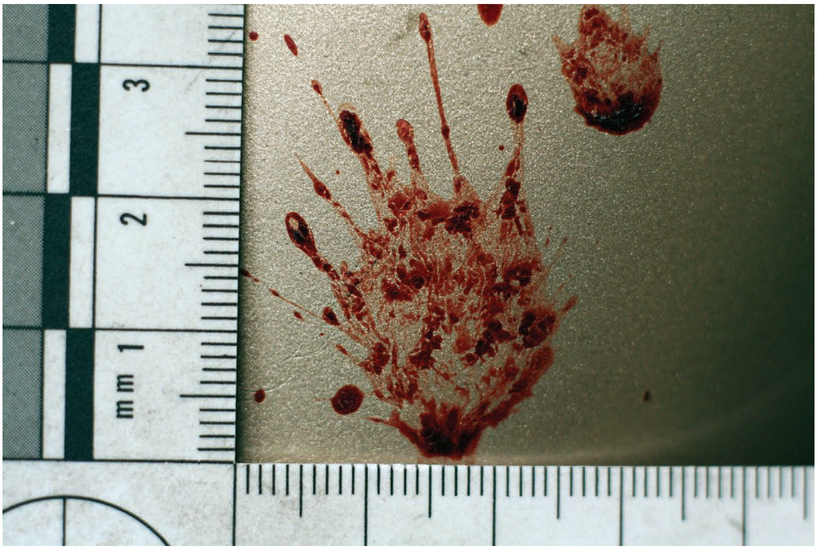


Figure 10.18 Edge Characteristics from around the periphery of the bloodstain and include features like spines, scalloped edges, and satellite stains. Those features can be seen on the top edge of the stain depicted here and they indicate the bloodstain was traveling from the bottom of the photograph upward.

- *Expiration Pattern*—A bloodstain pattern resulting from blood forced by airflow out of the nose, mouth, or a wound (Figure 10.19).
- *Flow*—A bloodstain resulting from the movement of a volume of blood on a surface due to gravity or movement of the target (Figure 10.20).

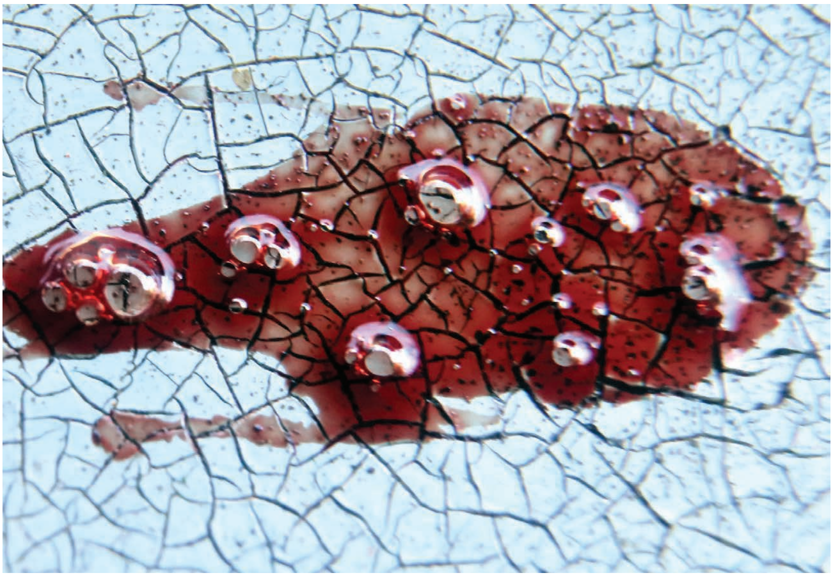


Figure 10.19 An Expiration Pattern is caused when blood is coughed or sneezed out of the body. Expiration patterns are most easily identified by the presence of air bubbles and saliva in the bloodstain.

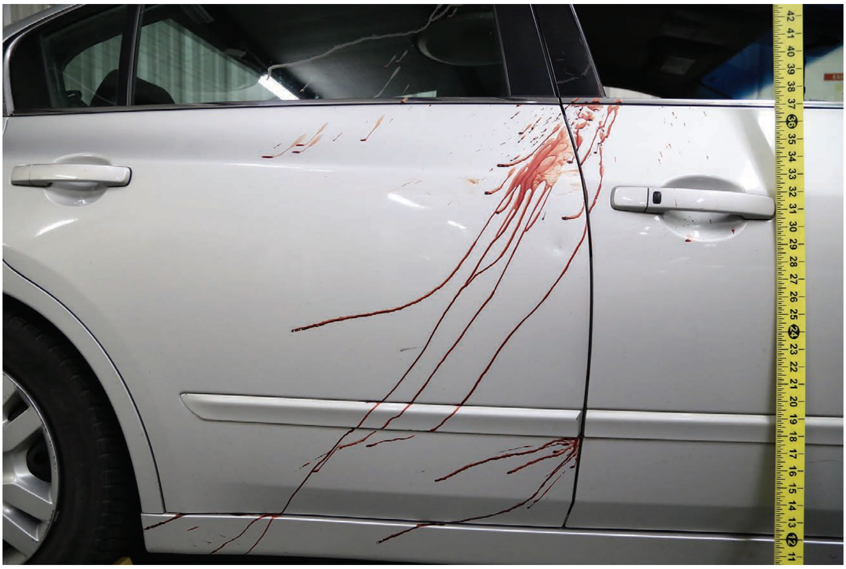


Figure 10.20 Blood Flow is one of the easiest stain patterns to recognize. They could be a part of another pattern, such as projected patterns from arterial gushes, but any stain pattern that drips down or across a subject is characterized as blood flow. The blood flow in this photograph was caused by gravity and wind, as the car moved forward, the blood was pushed toward the rear of the car.

- *Forward Spatter Pattern*—A bloodstain pattern resulting from blood drops which can be produced when a projectile creates an exit wound (Figure 10.21).
- *Impact Pattern*—A bloodstain pattern resulting from an object striking liquid blood (Figure 10.22).

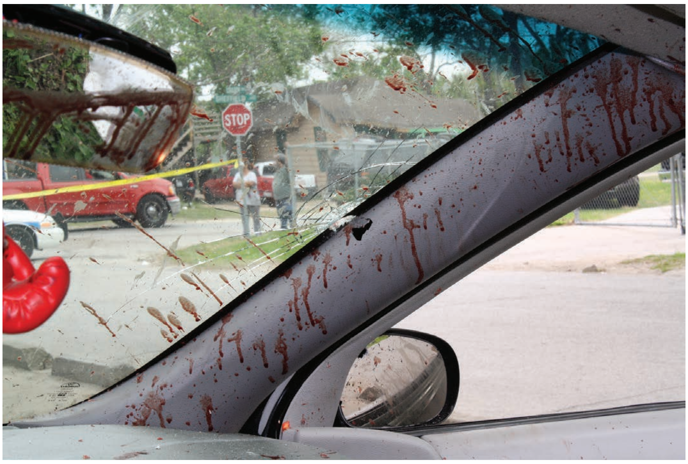


Figure 10.21 Forward Spatter is created when blood is ejected from an exit wound. In this photograph, one can see the fired bullet that passed through the victim's head and continued on and struck the car's windshield and "A" pillar.

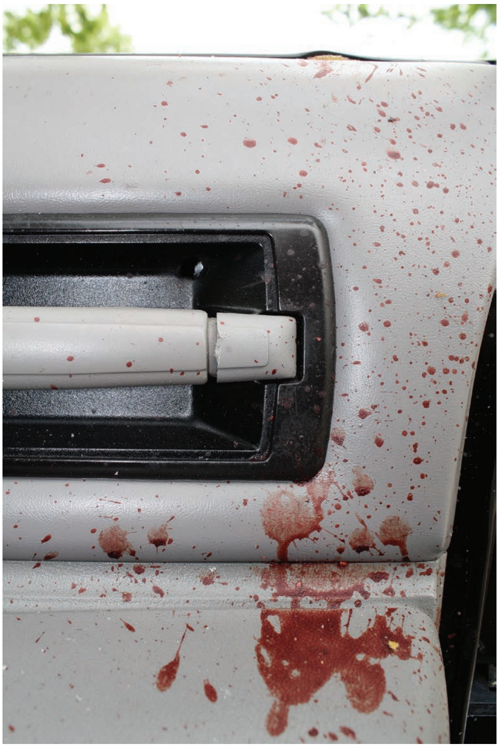


Figure 10.22 Impact bloodstain patterns are a very common pattern to find in vehicles involved in violent crimes. This Impact Pattern was created when the victim was struck multiple times with a blunt force object.

- *Insect Stain*—A bloodstain resulting from insect activity (Figure 10.23).
- *Parent Stain*—A bloodstain from which a satellite stain(s) originated (Figure 10.24).

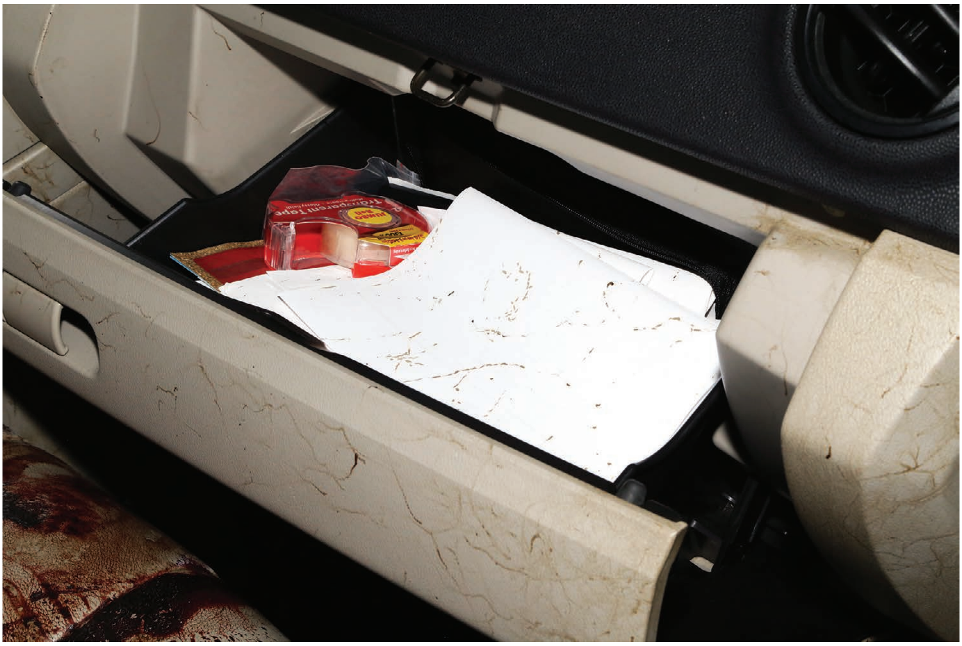


Figure 10.23 The victim in this vehicle was not found for approximately a week after his death. In that time, flies laid their eggs and those eggs matured into maggots. The maggots left trails of decomposed blood on the dashboard of the vehicle.

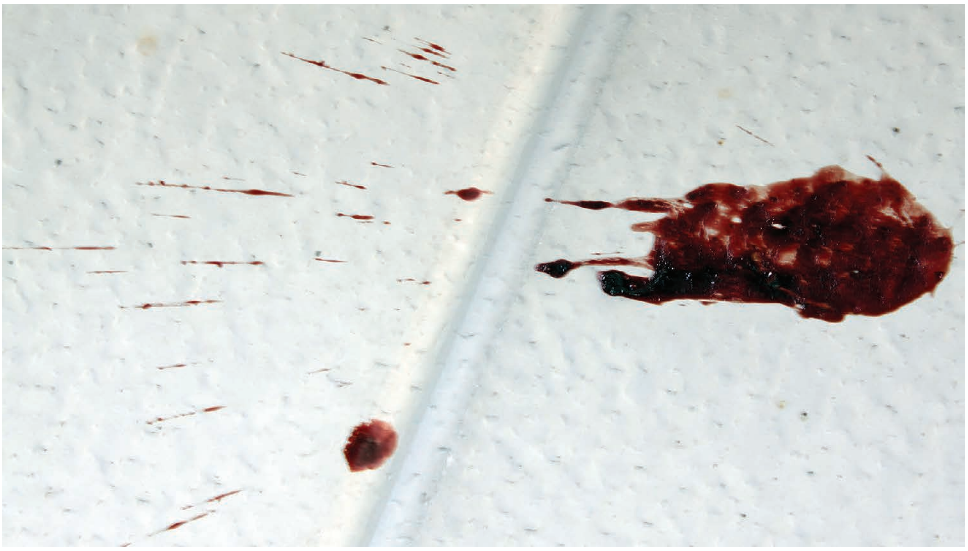


Figure 10.24 The Parent Stain is a blood droplet that strikes a target and breaks up upon impact, creating much smaller satellite stains along the periphery. Notice how most of the satellite stains are in line with the spines and shorter scalloped edges around the leading edge of the parent stain.

- *Perimeter Stain*—An altered stain consisting of its edge characteristics, the central area having been partially or entirely removed (Figure 10.25).
- *Pool*—A bloodstain resulting from an accumulation of liquid blood on a surface (Figure 10.26).

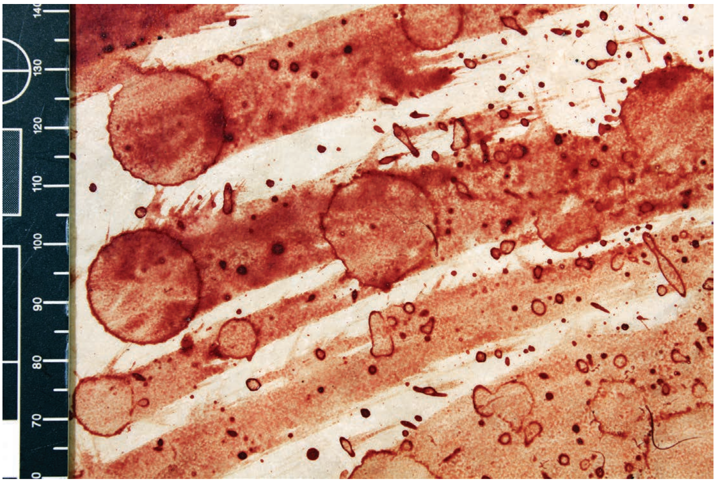


Figure 10.25 These Perimeter Stains were left behind after something wiped across the drip stains and removed the blood from the center of the stain.

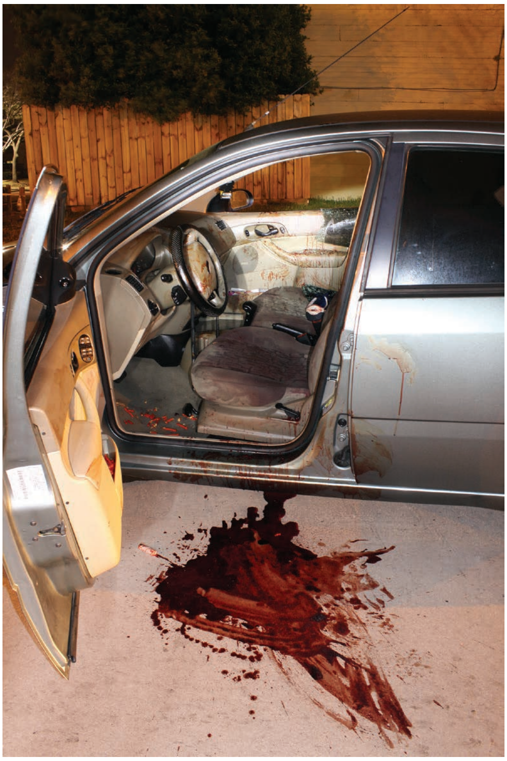


Figure 10.26 The victim in this vehicle dripped blood into an accumulation or Pool of blood just outside the driver's front door. Blood pools are commonly found on vehicle floorboards and seats.

- *Projected Pattern*—A bloodstain pattern resulting from the ejection of blood under hydraulic pressure, typically from a breach in the circulatory system (Figure 10.27).
- *Satellite Stain*—A smaller bloodstain that originated during the formation of the parent stain as a result of blood impacting a surface (Figure 10.28).

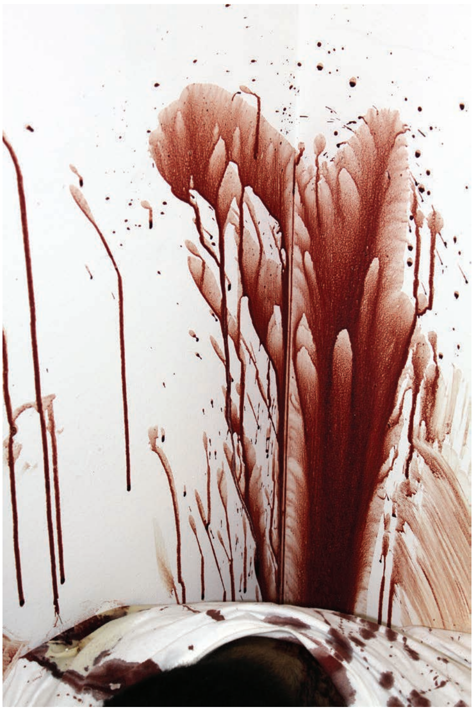


Figure 10.27 Projected Patterns are created when there is an injury to a victim's circulatory system, arteries, or veins. The stain patterns are typically much larger than other blood drip stains and have a great deal of volume, which is indicated by blood flow resulting from the projected pattern.

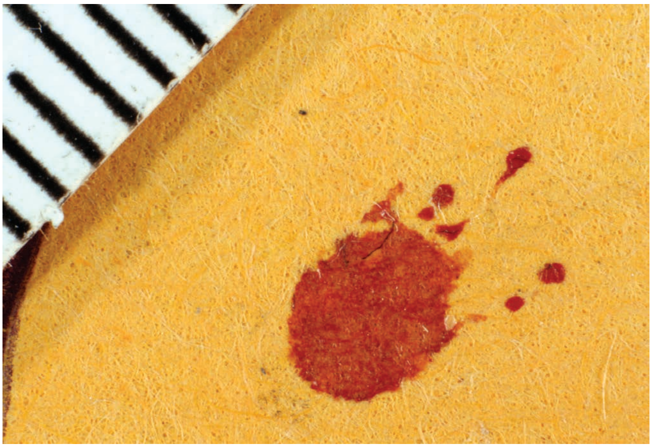


Figure 10.28 The smaller stains on the leading (right side of the bloodstain) edge of this bloodstain are known as Satellite Stains. Notice how the top-middle satellite stain has a small spine that points back to the parent stain. This is the time when the spine points in the opposite direction of a stain's direction of travel.

- *Saturation Stain*—A bloodstain resulting from the accumulation of liquid blood in an absorbent material (Figure 10.29).
- *Serum Stain*—The stain resulting from the liquid portion of blood (serum) that separates during coagulation (Figure 10.30).

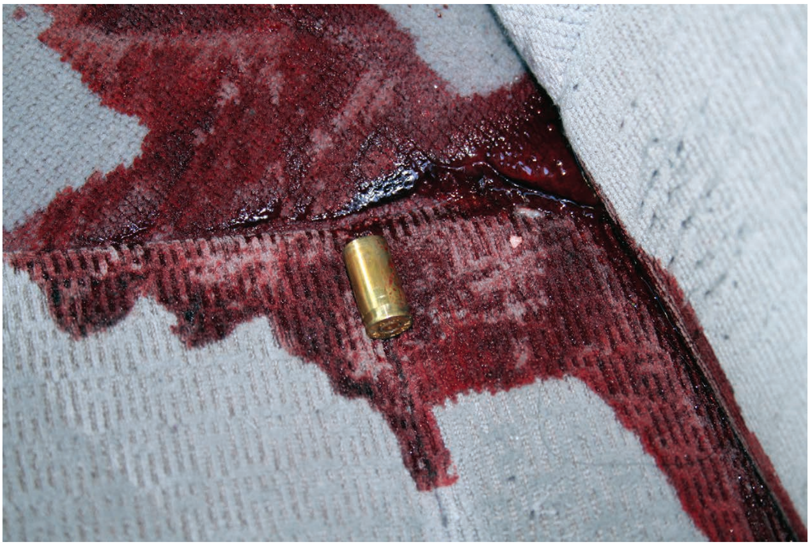


Figure 10.29 Saturation Stains occur when there is an accumulation of blood on absorbent material, like the fabric seats of a vehicle or the carpeted floorboards.

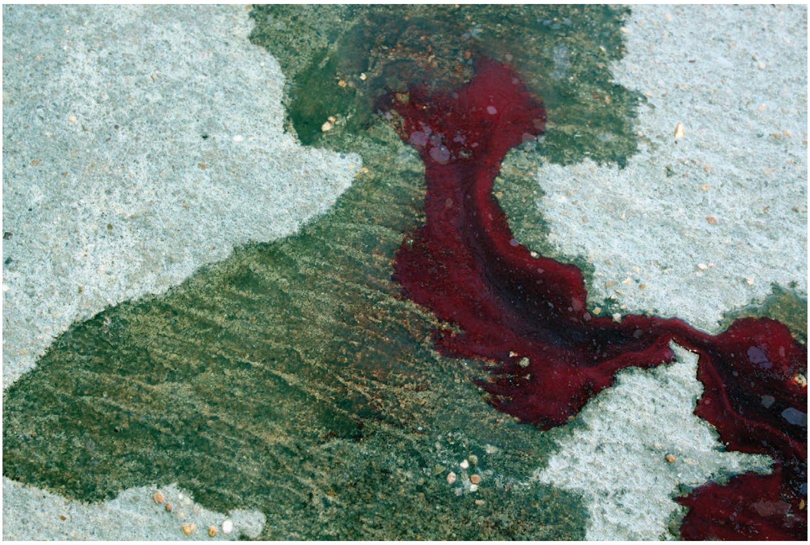


Figure 10.30 Blood is made up of approximately 55% plasma, the yellow or straw-colored liquid that contains the white blood cells and platelets. When the solids in blood coagulate, it leaves behind the plasma or Serum portion of the blood. These stains do not develop immediately, it takes time for the separation to occur. The time that it takes for blood to separate has several variables, including the health of the bleeding person, ambient temperature, and humidity.

- *Spatter Stain*—A bloodstain resulting from an airborne blood drop created when an external force is applied to liquid blood (Figure 10.31).
- *Splash Pattern*—A bloodstain pattern created from a large volume of liquid blood falling onto a surface (Figure 10.32).

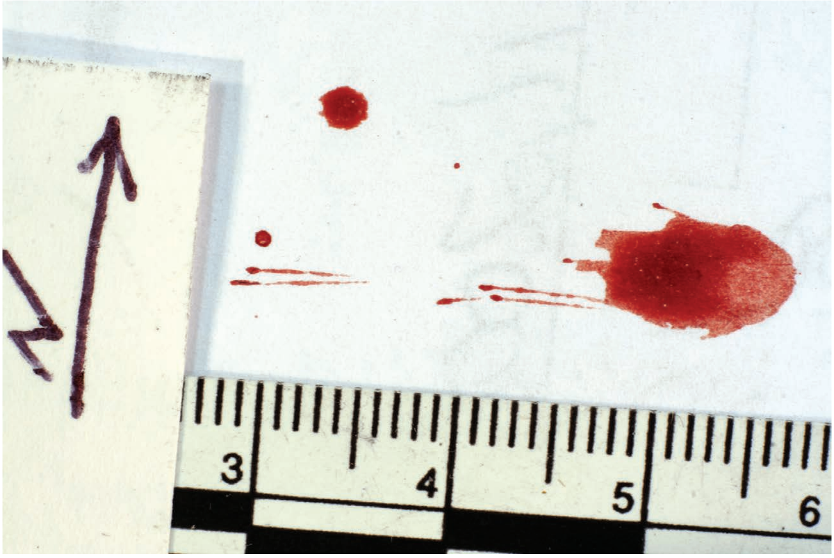


Figure 10.31 Spatter Stains are the individual stains that can make up an impact pattern. This stain was part of a larger pattern after the victim had her head crushed with a baseball bat. Notice how the bloodstain was traveling from right to left and how the spines on the satellite spatters are pointed back toward the parent stain.

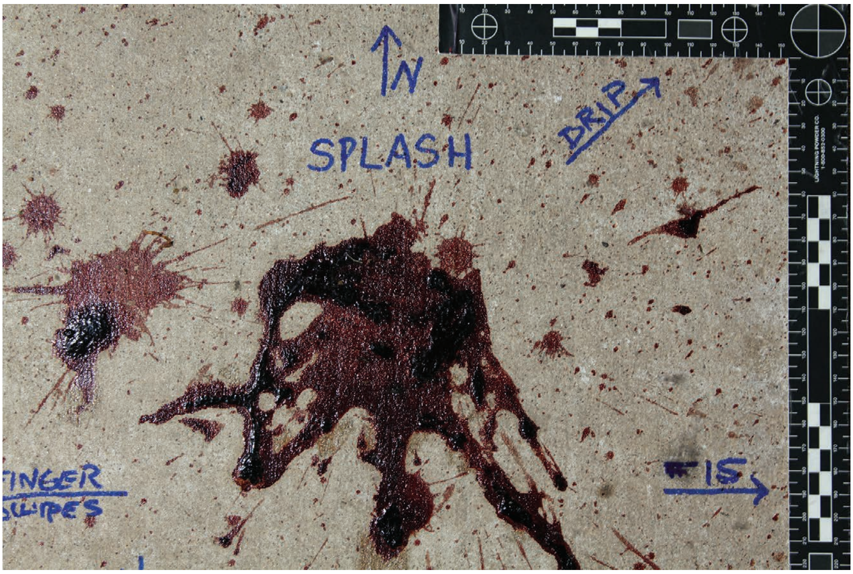


Figure 10.32 Splash Patterns are not commonly found in a vehicle, but may occur when an accumulation of blood is released all at once as shown in this photo of a shooting victim.

- *Swipe*—A bloodstain resulting from the transfer of blood from a blood-bearing surface onto another surface, with characteristics that indicate relative motion between the two surfaces (Figure 10.33).

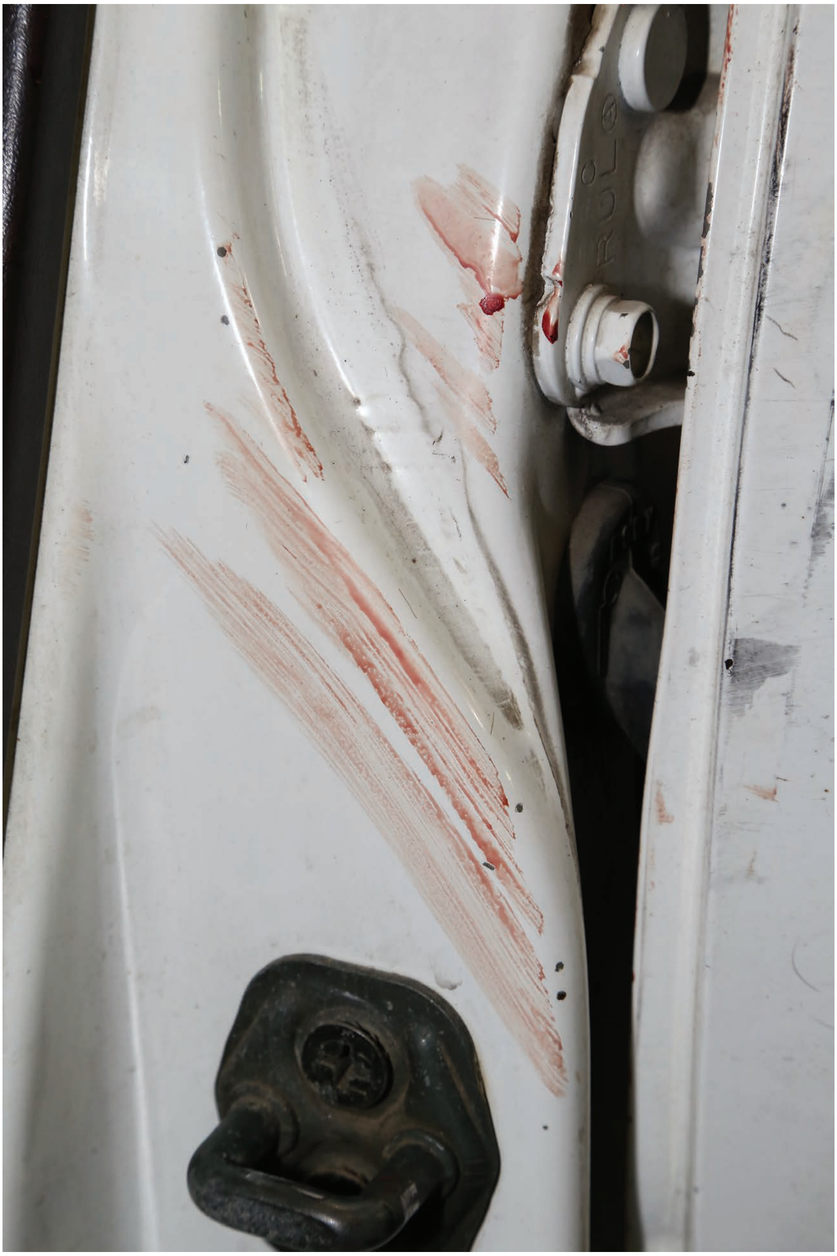


Figure 10.33 Swipes and wipes are frequently misidentified, one for the other. The stain in this photograph is a swipe and was left behind by a bloodstained hand onto a clean surface. There is a way to remember the difference between a swipe and a wipe and it is that a person "wipes their bottom with tissue, they do not swipe it." This analogy between one's bathroom protocols and bloodstain terminology may be odd, but it is accurate and helps one quickly differentiate between wipe and swipe patterns.

- *Target*—A surface onto which blood has been deposited (Figure 10.34).
- *Transfer Stain*—A bloodstain resulting from contact between a blood-bearing surface and another surface (Figure 10.35).

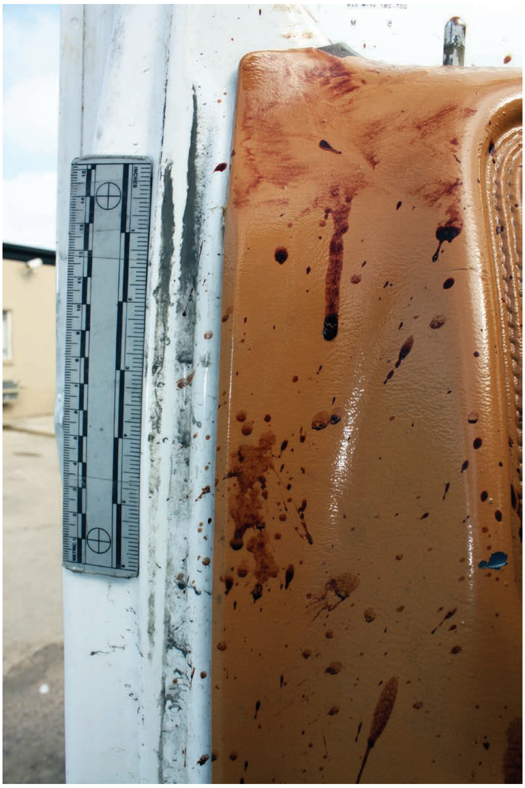


Figure 10.34 The bloodstained Target in this photograph is the interior door panel of the front driver's door.

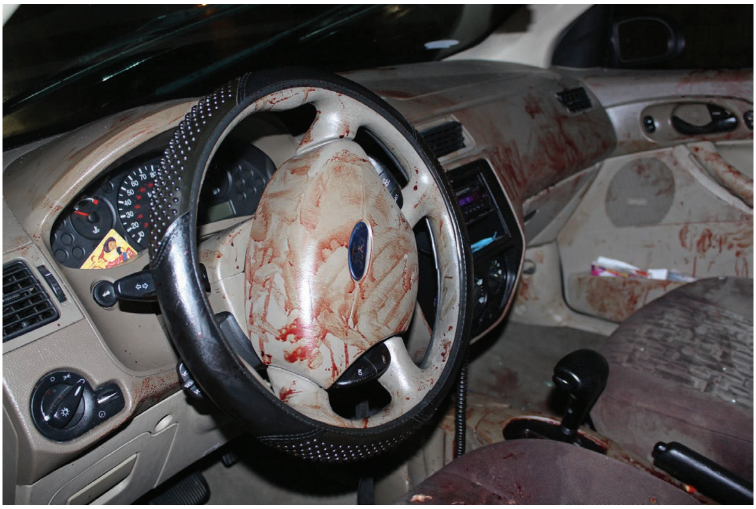


Figure 10.35 This Transfer Stain was created after the driver continued to drive and his bloodstained hands left behind transfer stains on the steering wheel.

- *Void*—An absence of blood in an otherwise continuous bloodstain or bloodstain pattern (Figure 10.36).

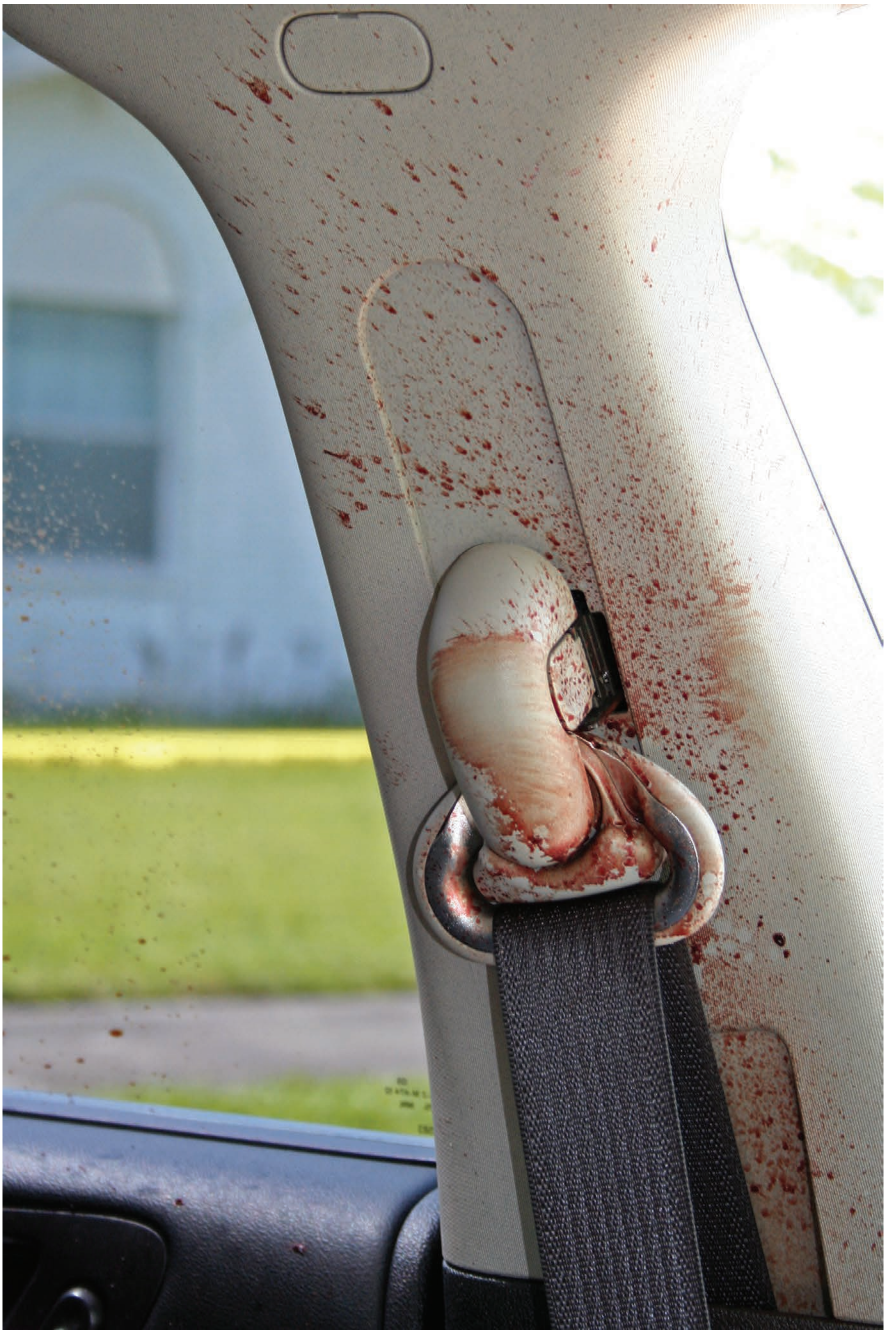


Figure 10.36 The Void in this photograph is located behind the seatbelt's shoulder guide and was created after the driver was shot in the head. The injury occurred with the victim's head positioned in front of the seatbelt guide based on the bloodstains' directionality and the position of the void pattern.

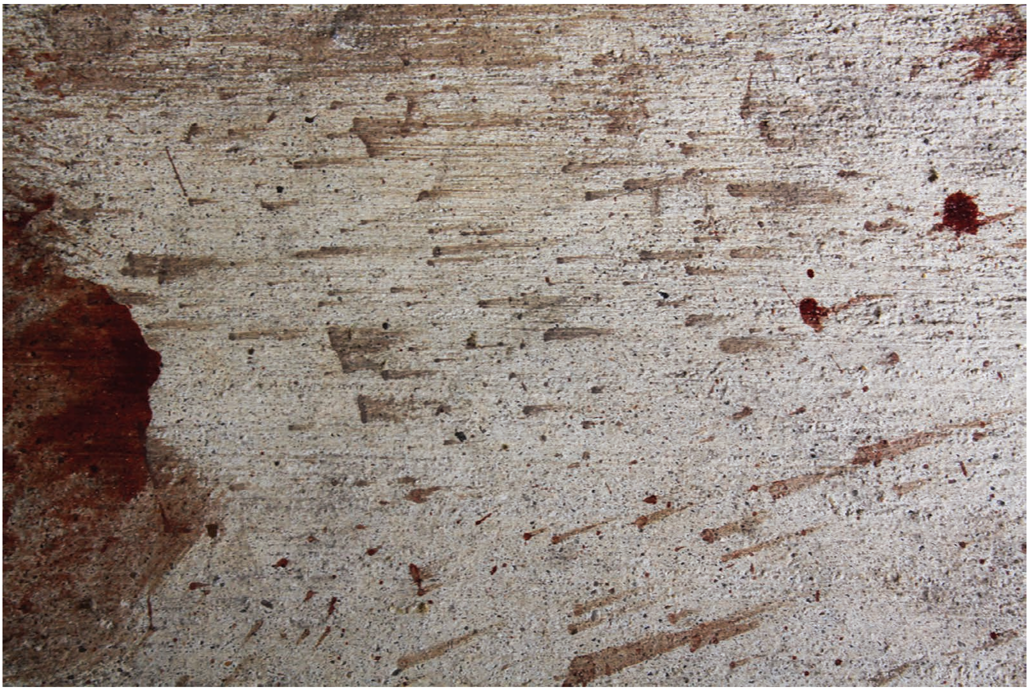


Figure 10.37 A Wipe pattern is the opposite of a swipe pattern. The wipe pattern in this photograph was created after bloodstains were deposited on the ground floor and then motioned through as the body was dragged over the preexisting stains.

- *Wipe*—An altered stain resulting from an object moving through a preexisting wet bloodstain (Figure 10.37).

Investigators, especially those who are new to the field of crime scene investigation, may be perplexed by the fine nuances between some of these terms, like a wipe versus swipe pattern. One aspect that can help the investigator look at a bloodstained vehicle is to understand that a single stain does not make a pattern and one needs to look at the vehicle using a holistic approach. Furthermore, bloodstains do not just magically appear. They were transferred, dispersed, or projected onto the vehicle's surface in some manner. Bloodstains and bloodstain patterns typically do not involve just a single drop of blood, even though a single drop of blood can be a very telling piece of evidence. Bloodstains are typically deposited in mass. There may be just a few bloodstains or hundreds, if not thousands, of individual stains. If one is unfamiliar with Bloodstain Pattern Analysis (BPA), then being able to articulate their size, shape, distribution, and orientation of the blood they observe on a vehicle is a good start.

Documenting the size, shape, distribution, and orientation of bloodstains are the four categories an evidence technician should try to describe and photograph in the vehicle's documentation. Bloodstains that travel in space or are transferred to a surface by direct contact, can help inform analysts about the amount of energy that occurred to create the bloodstain or stains. A blood source that is impacted with more or higher energy will create smaller bloodstains [Figure 10.38(a)]. The higher energy causes the blood to break up into smaller droplets of blood and in the case of a gunshot wound, those particles of blood can be pinpoint in size. Blood impacted by a lesser amount of force will still cause the blood to break up, but the resulting stains will be slightly larger, approximately 2–4 mm in diameter [Figure 10.38(b)]. Bloodstains that fall due to gravity are likely to be larger than 4 mm in diameter [Figure 10.38(c)]. The reason bloodstain pattern analysis is so challenging is that one cannot just measure a bloodstain and make an emphatic claim about the type

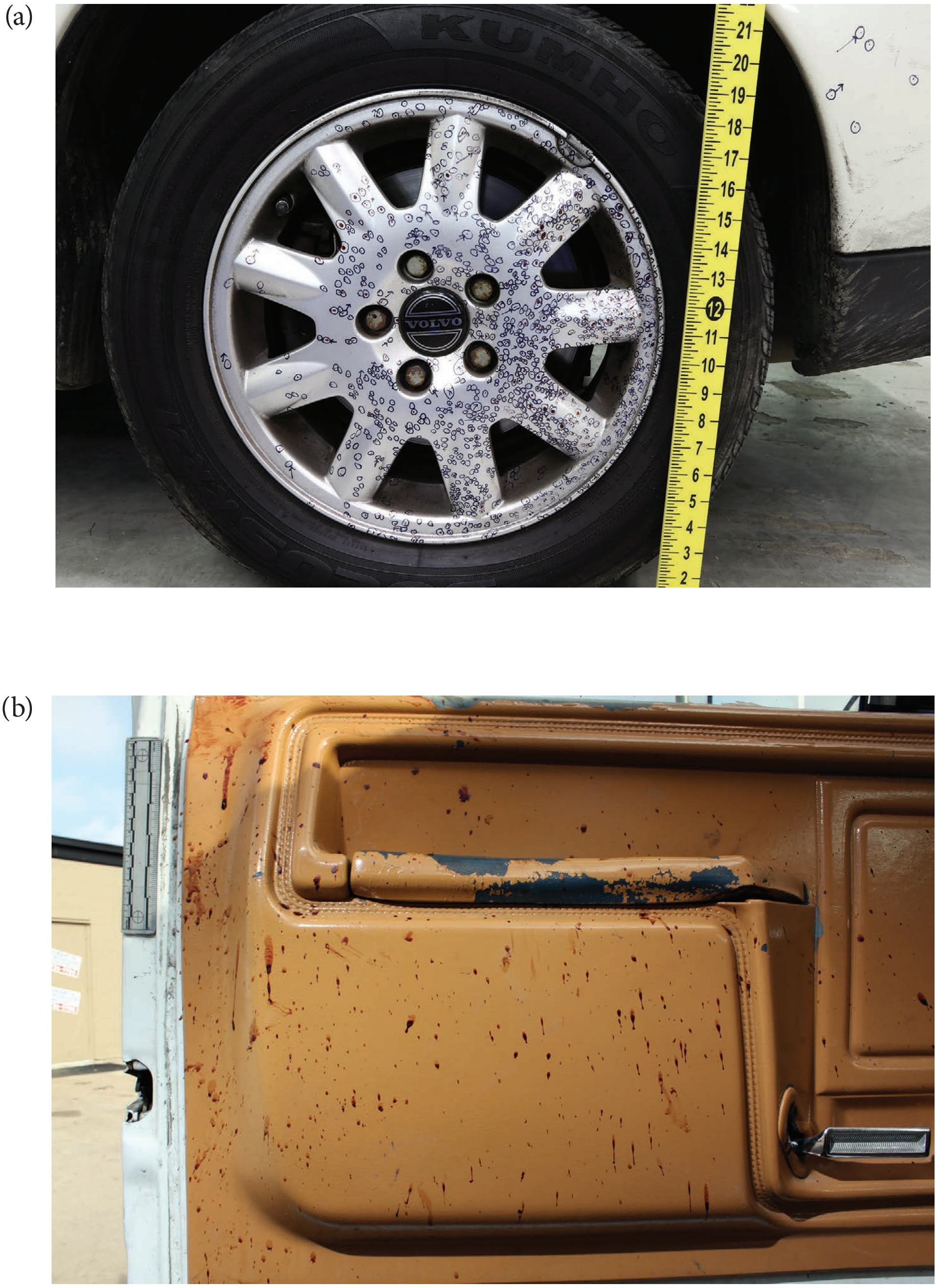


Figure 10.38 (a) The victim in this case suffered a gunshot wound while they hid behind the wheel of their vehicle, creating hundreds of small microdot bloodstains. (b) These bloodstains were created when the victim was struck with an axe (blunt force trauma).

(c)

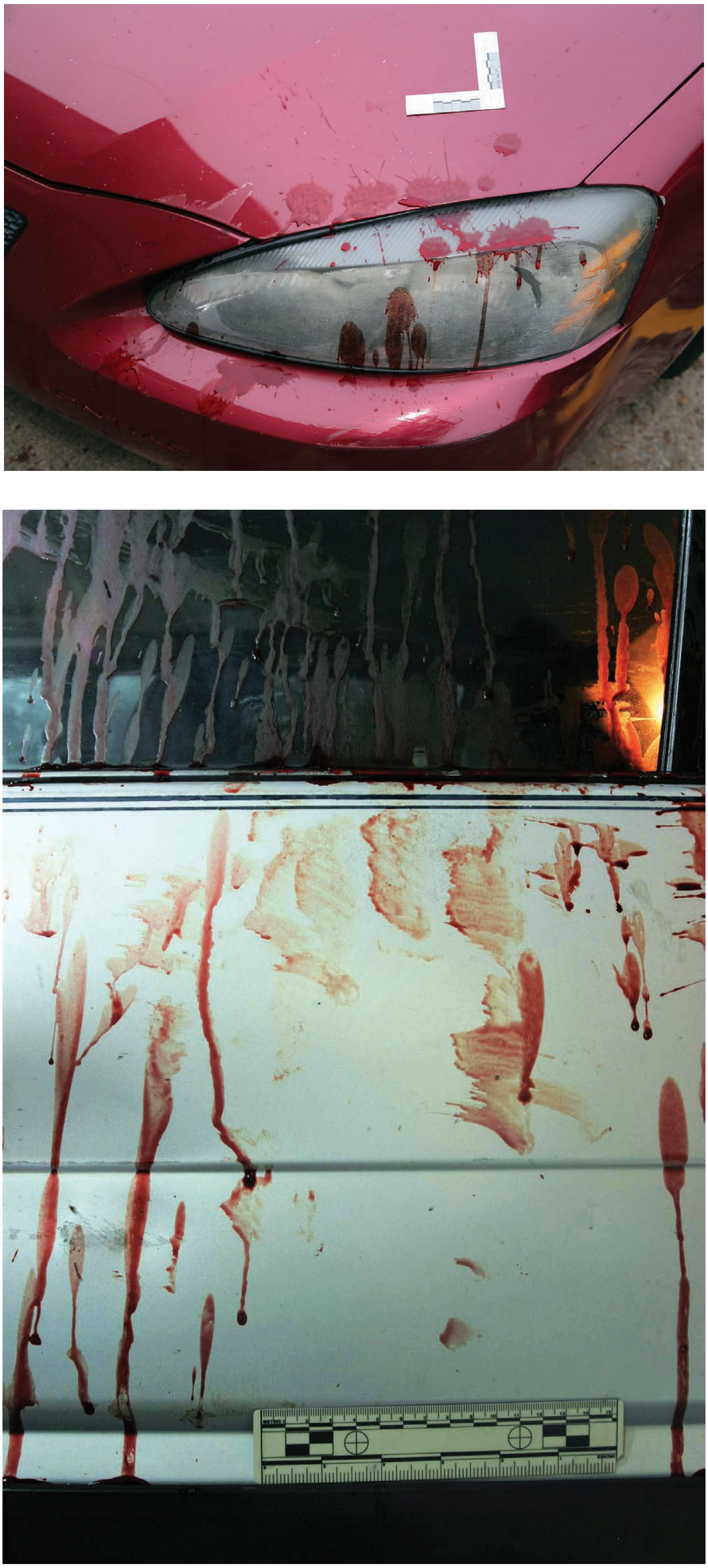


Figure 10.38 (Continued) (c) Gravity caused these bloodstains, as they fell from the victim's open wound onto the vehicle.

of force used to create it. Among the variables, there are accompanying drops and satellite stains that can trick a novice investigator into thinking a stain pattern was created with more force than it actually was. Therefore, one must look at everything on a vehicle and place what is seen into context. When an evidence technician is describing and measuring stains, they should start by looking at the preponderance of stains found and report the diameters of those stains. Size is just one aspect of looking at bloodstains, but it is an important one.

A bloodstain's shape is an extremely telling feature of a bloodstain. Blood droplets travel through the air in a spherical shape and when they contact a target or surface, they collapse. Depending on the angle at which the blood droplet struck a surface, the shape of the resulting bloodstain will appear different. Stains that strike at a 90° angle, like when a blood drop falls straight down due to gravity, will have a circular shape [Figure 10.39(a)]. As the impact angle becomes more acute, the resulting stains begin to turn into a more elliptical shape [Figure 10.39(b) and (c)]. The elliptical shapes actually have a mathematical relationship that allows for the calculations of angles of impact. The formula is the same as the formula used when measuring the elliptical bullet strikes found on a vehicle. To determine the angle of impact of a bloodstain, one needs to measure the width and the length and then use the formula: width divided by the length = sine of the angle. As an example, a bloodstain measured to be 3 mm wide and 9 mm long, the angle of impact would be determined as follows:

- Sine of the angle = width divided by the length (of the bloodstain)
- Or the inverse sine of the width divided by the length

(a)

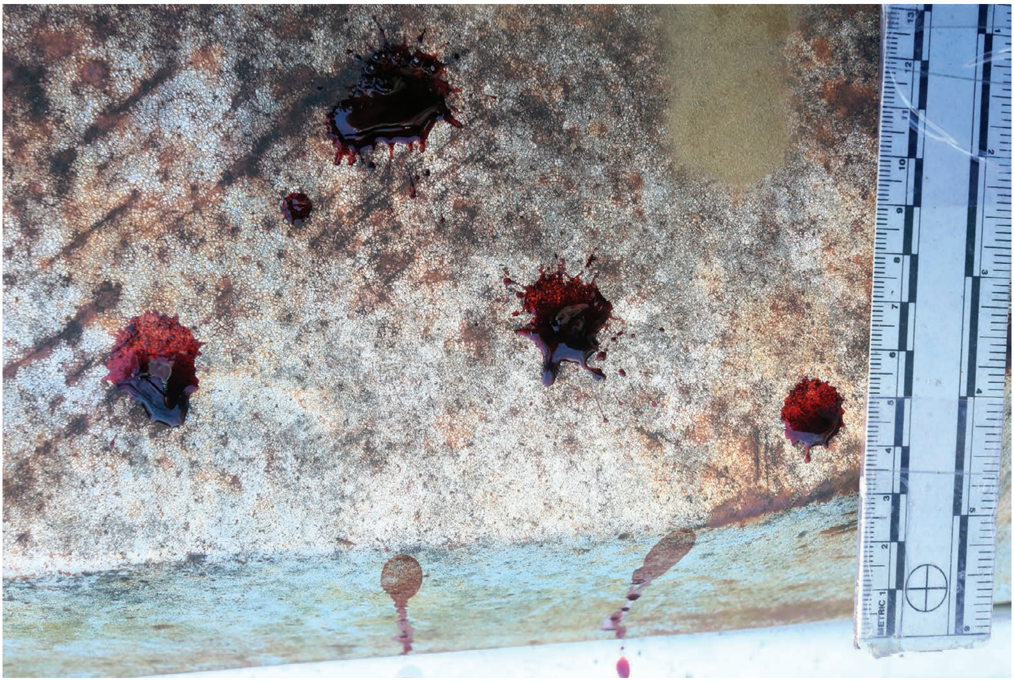
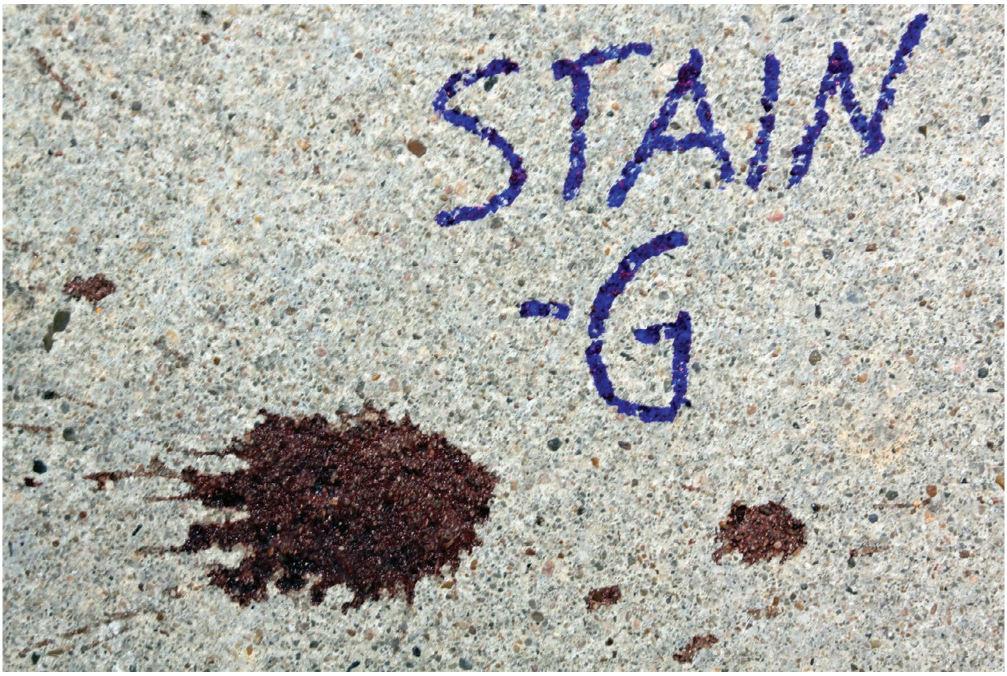


Figure 10.39 (a) A blood drop fell at a 90° angle onto the front edge of the vehicle's hood. Notice how the bloodstains that impacted the vertical portion of the hood were much more elongated.

(b)



(c)

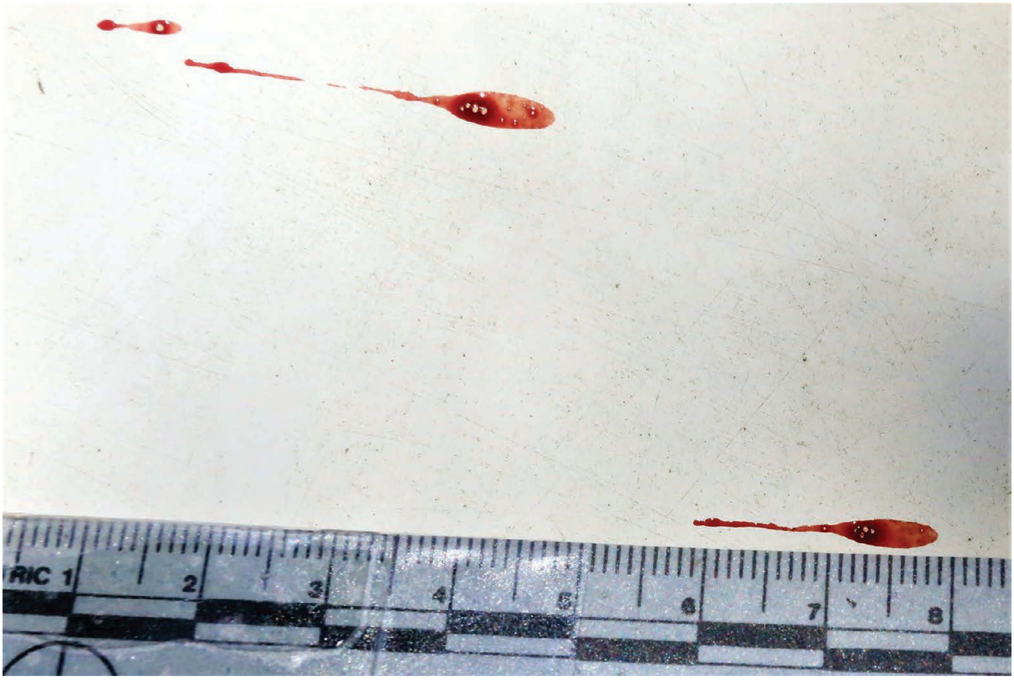


Figure 10.39 (Continued) (b) This bloodstain impacted the floor at approximately 60°. Notice the scalloped edges on the leading side (left) of the stain. The edge characteristics indicate that this stain (b) was traveling from right to left in the photograph. (c) This third bloodstain impacted at approximately 20°. Notice the long spines that developed on the leading edge of the stain, indicating that the stain was traveling from right to left.

- Example for a bloodstain measuring 9 mm long and 3 mm wide
    - *Formula*: Sine of the angle = 3 divided by 9
    - Sine of the angle = .3333
    - *Calculator entry*: Arc or inverse sine of .3333 (inverse sine may be achieved by pressing the “2nd” or “Inv” button prior to the sine button on one’s calculator)
    - Impact angle = 19.47 or rounded to 19.5°

Measuring bloodstains is more difficult than measuring bullet strikes. Similar to bullet strikes, the investigator needs to imagine a perfect ellipse for the stain. The challenge to this is that one may notice the presence of “scalloped edges” and “spines,” which develop on the leading edges of bloodstains. These features along the perimeter of some stains are not part of the bloodstain’s measurements. Because the measuring of bloodstains takes a great deal of practice, it is not something that should be attempted without proper training and that level of expertise is beyond the scope of this book. However, that does not prevent the documentation of these bloodstains through proper photography techniques, which is discussed in Chapter 5. Another challenge with bloodstains and motor vehicles is the lack of flat surfaces on vehicles. Most vehicles have curves and angles to them from front to back of the vehicle. One must account for such curvatures and angled surfaces when examining a vehicle for bloodstain evidence.

The final pair of concepts an investigator can use to help identify the meaning of bloodstain evidence is the distribution and orientation of bloodstains on the vehicle. Distribution looks at how the bloodstains are dispersed across a surface or surfaces. An investigator should look at the concentration of the bloodstains as well and document the observations in their written report. Void patterns, where bloodstains are expected but are not present, are additional important features to record in one’s notes and reports. Sometimes the locations where blood is not found are just as valuable as where it is found. As a final basic observation that should be made regarding bloodstain evidence is how bloodstains are oriented on a vehicle’s surface. All these general observations and notations should also include information about the specific and types of surfaces the stains were found on and the directionality that the bloodstains were traveling when impacting the target surface.

The evidence technician processing a bloodstained vehicle for evidence may be well versed in bloodstain pattern analysis techniques and knowledgeable about the science of bloodstain. However, that is a skill set developed over years of experience and far beyond the scope of this body of work. Until that day arrives, an investigator should strive for the proper documentation of bloodstains, recording information on their size, shape, distribution, and orientation. An investigator’s written report will be much more helpful to those who are qualified to complete a bloodstain analysis report when the original investigator is knowledgeable of the accepted bloodstain definitions and are able to identify bloodstains correctly. An investigator’s ability to place their observations in written form holds an unmeasurable value for bloodstain pattern analysts, but so does the ability to photograph bloodstained vehicles properly. The combination of these two abilities is the duty of every person examining a bloodstained vehicle so that an understanding as to what happened inside the vehicle can be fully understood.

Photographing Bloodstained Vehicles

The ability to accurately portray the bloodstain patterns in photographic form is another skill all crime scene investigators and evidence technicians should master. In order to record professional looking bloodstain photographs requires the recorded images possess quality lighting, focus throughout the composition, and that there is the proper orientation between the subject and camera. The photographic documentation of bloodstain evidence can be problematic for the photographer because of the tight confines of the vehicle, reflective surfaces, and the difficulty with getting quality lighting onto the subject. These difficulties are addressed more thoroughly in Chapter 5. One of the major complaints of bloodstain pattern analysts and crime scene reconstructionists is an incomplete photographic record of the crime scene or crime scene vehicle. This can be addressed with a technique known as "Roadmapping," which is discussed in this chapter. By understanding some of the pitfalls in accurately portraying a bloodstained vehicle and through proper documentation procedures, photographers can better present bloodstain evidence in court and assist other investigators who may be called upon to interpret stains found on a crime scene vehicle.

The lack of thoroughness may be the number one complaint bloodstain examiners have when reviewing a case. Failure by the scene investigator to completely and accurately photograph a bloodletting event can hinder any criminal investigation. Each and every stain pattern must be individually photographed in a manner by which the stain can be oriented within the vehicle and angles of impact or other important properties of the stain and/or pattern can be determined (Figure 10.40). Remember, one of the most important rules in crime scene photography is that the value of completeness always overrides the cost of film or space on the storage media. As a reminder, crime scene investigators must avoid tunnel vision. Bloodstains and bloodstain patterns only have meaning and value if they can be placed into context with the scene. Therefore, photographers must strive to completely document the whole vehicle and not just a few interesting bloodstains. In written form, the investigator needs to record the size, shape, distribution, and orientation of bloodstains. The photographer of those same bloodstains and bloodstain patterns has the same responsibility: to record them as completely as possible.

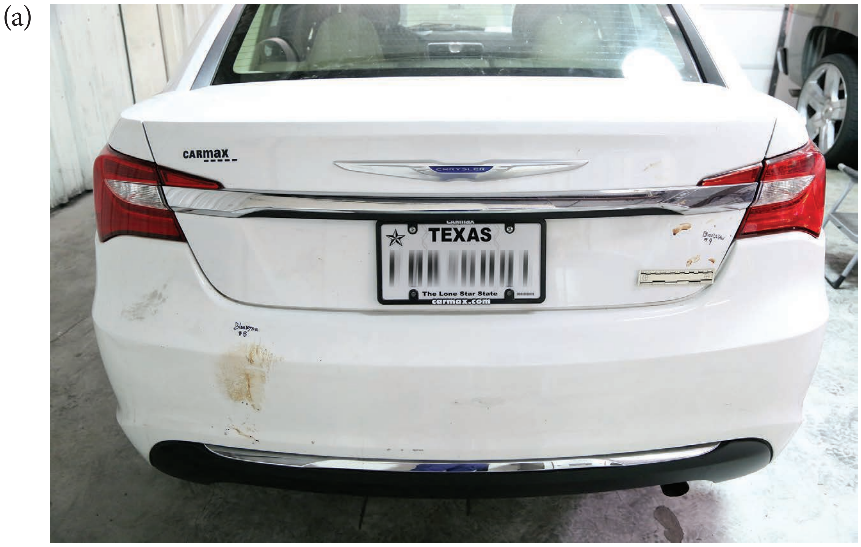
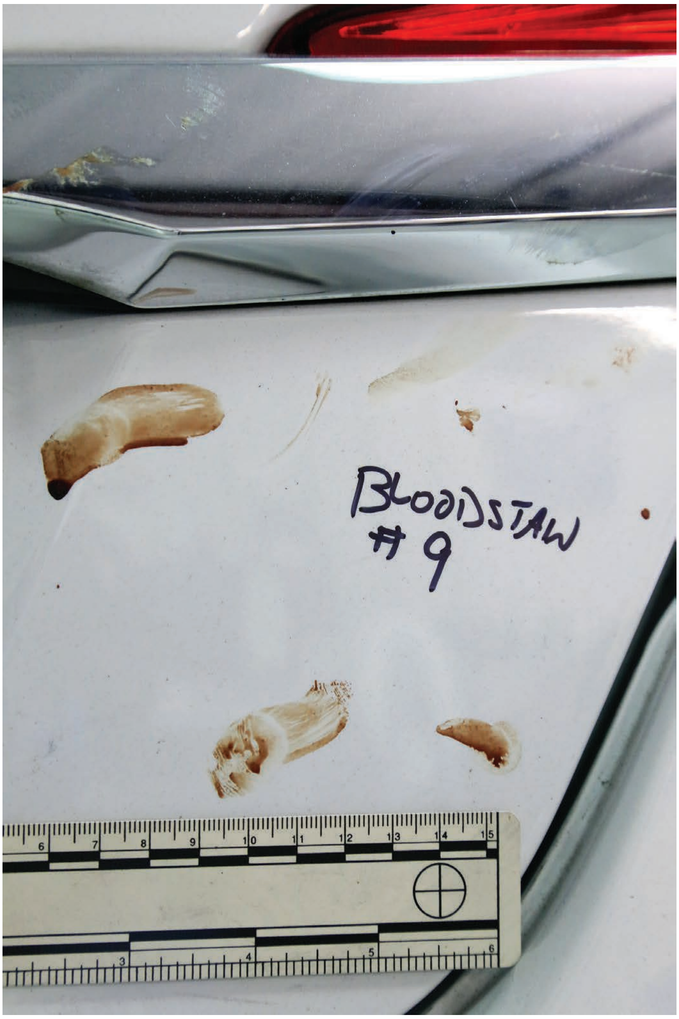


Figure 10.40 Photographers should not allow themselves to develop tunnel vision and simply photograph individual patterns without first having a point of reference for the stain's location. Comprehensive documentation is a must if a bloodstain examiner is going to be called upon to review a case. Images (a) through (c) illustrate the natural progression of any crime scene photographic sequence: (a) overall, (b) mid-range, and (c) close-up photographs.

(b)



(c)

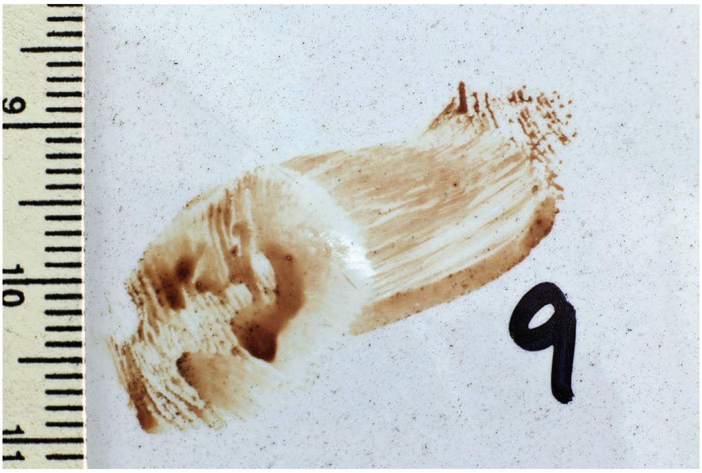


Figure 10.40 (Continued) Images (a) through (c) illustrate the natural progression of any crime scene photographic sequence: (a) overall, (b) mid-range, and (c) close-up photographs.

This tunnel vision can be avoided by realizing that every stain that is worth documenting at a close-up level also needs to be oriented to, and within, the entire vehicle. Therefore, photographers should not focus on individual stains and individual patterns without first putting them into context or showing their relationship with other pieces of evidence or their position within a vehicle. Photographers must consider the “big picture” in their overall body of work. Individual stains and stain patterns photographed for specific detail of size and shape are important, but those same stains must also be photographed to show their relationship to other stains present in the scene (distribution) and to the overall vehicle itself (orientation).

There is not much difference between the documentation of a bloodletting event and the documentation of any other criminal activity. Unfortunately, it is quite common and easy to get complacent when documenting bloodstained crime scenes. Investigators simply must be aware of this possibility of looking at a scene without taking into account that a full and proper documentation of bloodstained evidence can help refute or corroborate witness statements. True and accurate bloodstain photography requires an honest commitment to both recording a sufficient number of images in order to ensure that the scene is fully documented, and a commitment to creating images of excellent quality so that an examiner who was not present at the crime scene can perform a viable reconstruction.

The concept of “Roadmapping” is an effective way to maintain the goal of recording a complete record of the bloodstains and bloodstain patterns found at a crime scene or on a vehicle. The idea of roadmapping was first introduced by Toby Wolson of the Miami-Dade Police Department’s Forensic Services Bureau. Roadmapping is a way in which bloodstains and bloodstain patterns are recorded thoroughly. The technique operates much like the name sounds. The investigator photographs the area containing the bloodstains under examination and places “road signs” on or around the area being documented. The road signs can be plain arrows that point out specific stains, areas of convergence, or simply the directionality of stains and stain patterns. Another option is to use numbered or lettered road signs (markers) to point out the important features of the bloodstain patterns (Figure 10.41). It is

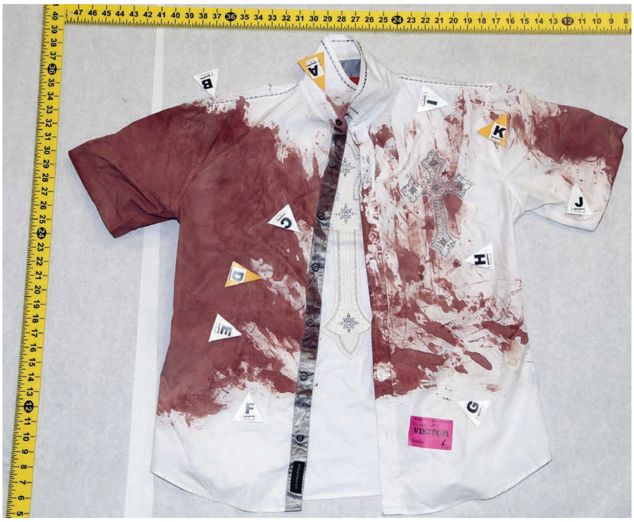


Figure 10.41 When photographing bloodstain patterns, placing pointers or evidence markers on the bloodstain target’s surface, will help bloodstain pattern analysts review the stain patterns and be able to better decipher what may have happened during a bloodletting event.

also recommended to place some sort of scale around the perimeter of the area being examined. The scales should be identifiable from the distance the photograph is recorded from. When the close-up photographs are recorded, smaller centimeter scales are appropriate. Another reminder for photographers is to maintain a perpendicular alignment between the camera's lens and subject. Curved surfaces on a vehicle may present a challenge, but one should simply be cognizant of the surface being photographed and the lens kept as close to a perpendicular relationship as possible. A tripod mounted camera can help with subject alignment.

Chemical Tests and Processes

During the documentation and evidence collection process of bloodstains, it is always a good idea to conduct a presumptive test for blood on one of the stains in the more significant bloodstain patterns found on a vehicle. The most common presumptive blood test is known as phenolphthalein. A phenolphthalein test turns a bright pink color in the presence of blood. The phenolphthalein test is not the only presumptive test kit available. Besides phenolphthalein, there is luminol, MacPhail's reagent, and Leucomalachite Green (Figure 10.42). These different tests are completed in individual manners. Investigators need to follow the manufacturer's directions to interpret the results correctly. Although these tests are highly reliable, they are still just presumptive tests for blood and a stain samples should still be collected from the pattern. If there is only one drop of suspected blood, especially a very small drop of blood, then a swabbing sample should be collected as evidence first and if any part of the stain remains, then that can have a presumptive test performed if so desired. Even if a stain sample returns as a negative, if the pattern or

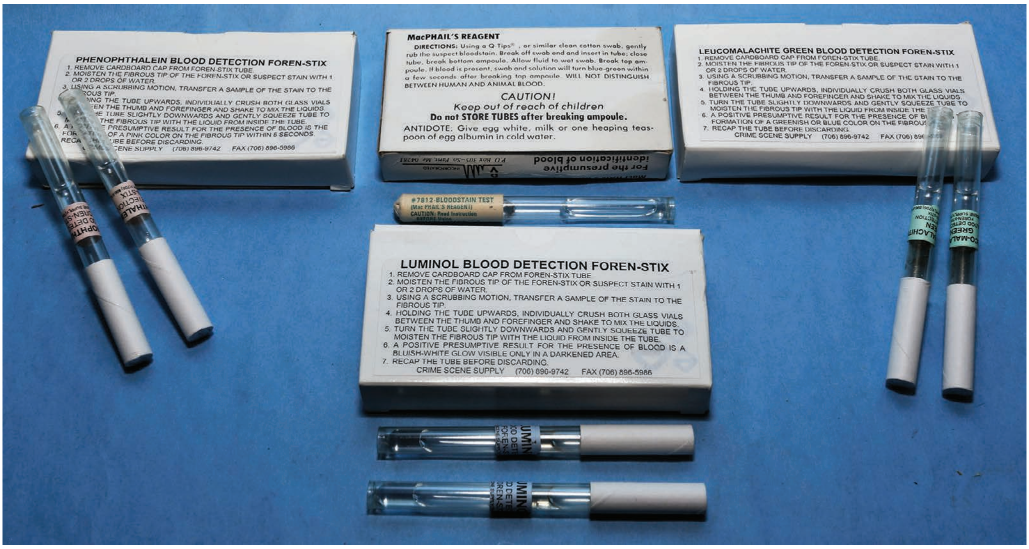

PHENOPHTHALEIN BLOOD DETECTION FOREN-STIX
MacPHAIL'S REAGENT
LEUCOMALACHITE GREEN BLOOD DETECTION FOREN-STIX
#7812-BLOODSTAIN TEST
LUMINOL BLOOD DETECTION FOREN-STIX

Figure 10.42 Crime scene investigators will often use a variety of presumptive test kits to ascertain whether an unknown stain is blood or not. Photographed here are an assortment of such presumptive test kits, including phenolphthalein, Leucomalachite Green, MacPhail's Reagent, and luminol.

individual stain seems relevant, an evidentiary collection should nonetheless be made. During the case review, either by the case investigator or a court officer, the question is bound to be asked, “If the stain was not blood, then what was it?” By having an evidentiary collection, then that question can be answered.

The Kastle-Meyer® presumptive blood test kit is another type of phenolphthalein and turns pink with a positive result. Hemastix® is also a presumptive blood test and is much easier to use (Figure 10.43). Hemastix was originally used to detect the presence of blood in urine but can be used effectively by crime scene investigators. The Hemastix tests come on thin plastic tabs that have a small absorbent area at one end. To conduct the test, an investigator moistens the tip of a swab with distilled water and collects a sample of the unknown stain. The swab is then pressed into the spongy material on the Hemastix tab and if the tab turns green, then the test is positive for blood. None of these tests discriminate between human and animal blood. This is another reason that evidentiary stain samples should be collected, so that additional confirmatory tests may be completed.

The use of luminol and Bluestar is used to find hidden sources of blood. They are not used to identify bloodstain patterns, although it may be possible to recognize a bloodstain pattern in the results with luminol or Bluestar. The use of these two chemicals is discussed more thoroughly in Chapter 7. Bloodstains can be diluted in a number of ways, such as by water, by the clotting mechanism within blood, and by cerebral fluid mixed with blood in the case of devastating head wounds. These bloodstains are not necessarily hidden, but may need some enhancement through chemical processes in order to recognize an array of different patterns. A couple of popular blood enhancement chemicals include Leuco Crystal Violet (LCV) and Amido Black.

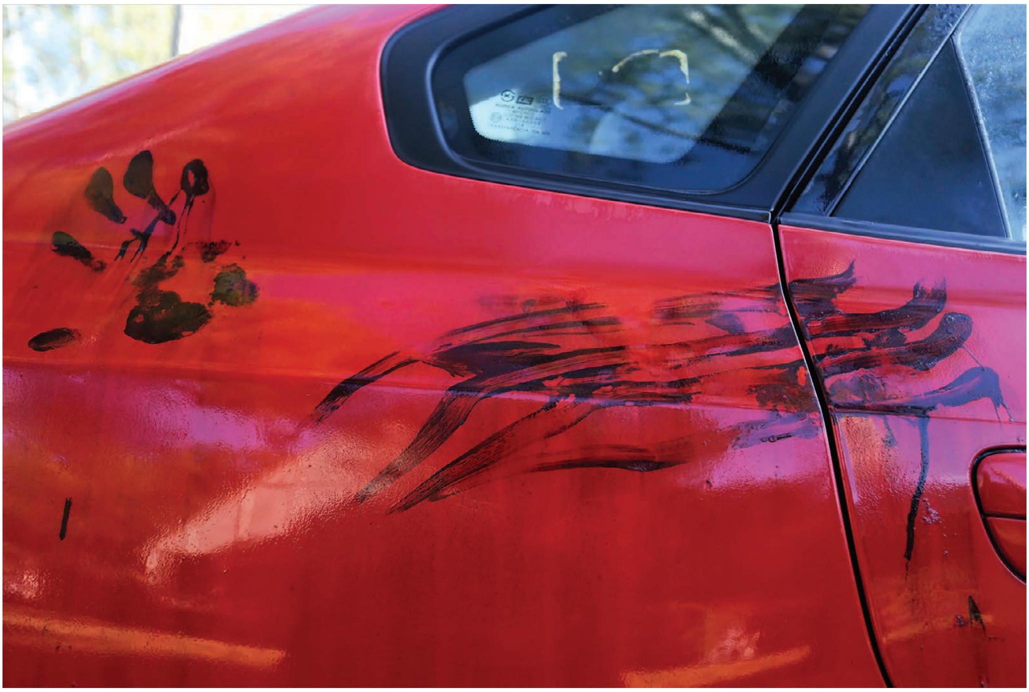


Figure 10.43 Amido Black was applied to the passenger side of the vehicle to help create contrast between the red bloodstains and the red vehicle.

LCV is a very easy process to use for the enhancement of bloodstains. However, as with any chemical process or enhancement technique, an investigator is always better off practicing the technique outside of an actual crime scene prior to attempting a process during a true crime scene. LCV stains blood and its components a purple or violet color and can turn faint impressions much darker and therefore, more identifiable. LCV is sprayed across the surface being examined in a one-step process. The investigator should be careful not to overspray, so that any fine details of the pattern, especially fingerprint patterns, are not blurred. Therefore, the evidence technician should apply the chemical sparingly and if necessary, add more cautiously. Amido Black is a similar product, but turns the bloodstains a dark blue (Figure 10.43). Amido Black is a two-step process, by which the chemicals are applied to the area under examination. Amido Black is first applied just like LCV, with the same care as to not over saturate the area with the chemical. The evidence technician should watch as the bloodstain pattern develops and at the point that the technician is happy with the contrast, they will apply the second chemical, which is a rinse solution. Whichever chemical process is chosen by an investigator, they should definitely photograph the results. The application of any chemical to a motor vehicle should be one of the last tasks performed by an investigator, because of the contamination of any other evidence that might still remain on the vehicle.

Conclusion

Any investigator who is involved in the processing of vehicles that are a part of violent crimes is bound to encounter bloodstained ones. And at times, that blood is going to seem overwhelming. Bloodstain Pattern Analysis requires a significant amount of training and experience to become competent in the science. If an investigator possesses such a skill set, then the task of documenting a vehicle is going to be much easier because they will be able to better identify the important aspects of the bloodstain patterns found on the vehicle. Even without the expertise of bloodstain pattern training, an investigator still has the responsibility to fully document the bloodletting event, both in photographic and written forms. When writing the descriptions of a bloodstain report, recognizing the individual stains and stain patterns is helpful to an analyst that might look at the case at a later time. In addition, using proper terminology is critical so that the analyst has a clear understanding of what was observed in the vehicle. If an investigator is not comfortable identifying a particular stain or pattern, then they can describe the size, shape, distribution, and orientation of the stains and that will be of great assistance to the analyst. Photographing the bloodletting event is equally important, using all the photographic skills of the investigator. When documenting bloodstains and patterns, sometimes the sheer volume of blood can make the recognition of important aspects of the scene difficult. By placing signposts in the photographs, also known as “Roadmapping,” will help keep stains and stain patterns organized and oriented to the vehicle. All investigators should be encouraged to properly document a vehicle in all aspects of the investigation and the one way to improve one’s skill is to objectively review their own work and seek to improve with each subsequent scene or vehicle. In the end, a thorough and meticulous documentation of any vehicle is worth its weight in gold.

Additional Readings

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Review Questions: Bloodstain Documentation and Processing

1. Which professional association board certifies bloodstain pattern analysts?
    a. International Association for Identification
    b. International Association of Bloodstain Pattern Analysts
    c. Organization of Scientific Area Committees for Forensic Science
    d. National Institute of Standards and Technology
2. The investigator documenting a bloodstained vehicle must be the person who completes the expert bloodstain pattern analysis report.
    a. True
    b. False
3. When was the National Academy of Sciences report "Strengthening Forensic Science in the United States: A Path Forward" released?
    a. 2006
    b. 2009
    c. 2013
    d. 2017
4. Which Scientific Area Committee does bloodstain pattern analysis fall under?
    a. Crime Scene/Death Investigation
    b. Biology/DNA
    c. Physics/Pattern Interpretation
    d. Chemistry/Instrumental Analysis
5. Who oversees the Organization of Scientific Area Committees for Forensic Science?
    a. International Association for Identification
    b. National Institute of Standards and Technology
    c. Department of Justice
    d. Federal Bureau of Investigation

6. Which of the following subcommittees does not belong to the Scientific Area Subcommittee containing the Bloodstain Pattern Analysis Subcommittee?
    a. Friction Ridge (Fingerprints)
    b. Firearms and Toolmarks
    c. Forensic Document Examination
    d. Serology and DNA Analysis
7. What has the Bloodstain Pattern Analysis Subcommittee published to help guide those working in the field of bloodstain pattern analysis?
    a. Congressional legislation
    b. Standards and guidelines
    c. Standard operating procedures
    d. Scientific methodology protocols
8. What is defined as a small blood drop produced as a by-product of drop formation?
    a. Bloodstain
    b. Drip stain
    c. Parent stain
    d. Accompanying drop
9. What is defined as a grouping or distribution of bloodstains that indicates through regular or repetitive form, order, or arrangement the manner in which the pattern was deposited?
    a. Drip pattern
    b. Bloodstain pattern
    c. Cessation pattern
    d. Impact pattern
10. What is defined as the characteristic of a bloodstain that indicates the direction blood was moving at the time of deposition?
    a. Directionality
    b. Directional angle
    c. Area of convergence
    d. Area of origination
11. What is defined as a physical feature of the periphery of a bloodstain?
    a. Perimeter stain
    b. Edge characteristic
    c. Altered stain
    d. Satellite stain
12. What is defined as a bloodstain pattern resulting from an object striking liquid blood?
    a. Forward spatter pattern
    b. Cast-off pattern
    c. Impact pattern
    d. Splash pattern
13. What is defined as a bloodstain pattern resulting from the ejection of blood under hydraulic pressure, typically from a breach in the circulatory system?
    a. Projected pattern
    b. Impact pattern
    c. Forward spatter pattern
    d. Cast-off pattern

14. What is the definition of a Satellite Stain?
    a. A bloodstain resulting from a falling drop that formed due to gravity.
    b. A deposit of blood on a surface.
    c. A smaller bloodstain that originated during the formation of the parent stain as a result of blood impacting a surface.
    d. A small blood drop produced as a by-product of drop formation.
15. What is the definition of a Swipe?
    a. An altered stain resulting from an object moving through a preexisting wet bloodstain.
    b. A bloodstain resulting from the transfer of blood from a blood-bearing surface onto another surface, with characteristics that indicate relative motion between the two surfaces.
    c. A bloodstain resulting from contact between a clean surface and another blood-bearing surface.
    d. A grouping or distribution of bloodstains that indicates through regular or repetitive form, order, or arrangement the manner in which the pattern was deposited.
16. What is the definition of Area of Origin?
    a. The space in three dimensions to which the trajectories of spatter can be utilized to determine the location of the spatter-producing event.
    b. The space in two dimensions to which the directionalities of spatter stains can be retraced to determine the location of the spatter-producing event.
    c. The angle (alpha), relative to the plane of a target, at which a blood drop strikes the target.
    d. The angle (gamma) between the long axis of a spatter stain and a defined reference line on the target.
17. What color does a phenolphthalein test show when there is a positive result for blood?
    a. Red
    b. Pink
    c. Green
    d. Violet
18. What color does a Hemastix test show when there is a positive result for blood?
    a. Red
    b. Pink
    c. Green
    d. Violet
19. When should chemical reagents such as Amido Black or Leuco Crystal Violet be used during the processing of a vehicle for blood evidence?
    a. At the beginning, before any other processes can affect results
    b. At the point when the bloodstain or pattern has been found
    c. After securing a special search warrant for biological material
    d. After all other processes have been completed

20. What is the name of the bloodstain documentation process developed by Toby Wolson of the Miami-Dade Police Department's Forensic Services Bureau?
    a. Quadrant mapping
    b. Road mapping
    c. Bloodstain mapping
    d. Sequence mapping

Review Question Answer Keys

Chapter 2

1. b
2. c
3. a
4. d
5. b
6. a
7. d
8. b
9. c
10. a
11. d
12. c
13. b
14. b
15. a
16. c
17. a
18. c
19. c
20. b

Chapter 3

1. b
2. c
3. a
4. b
5. d
6. d
7. a
8. b
9. a
10. c
11. c
12. d
13. b
14. a
15. b
16. b
17. c
18. d
19. c
20. b
21. b
22. d
23. c
24. a
25. b

Chapter 4

1. a
2. c
3. a
4. b
5. c
6. a
7. d
8. c
9. a
10. b
11. c
12. b
13. b
14. a
15. b

Chapter 5

1. d
2. b
3. a
4. d
5. c
6. d
7. a
8. d
9. c
10. a
11. c
12. c
13. b
14. b
15. a
16. d
17. b
18. c
19. a
20. d

Chapter 6

1. a
2. a
3. d
4. c
5. b
6. b
7. c
8. d
9. a
10. a
11. c
12. d
13. b
14. d
15. c
16. a
17. b
18. d
19. c
20. a

Chapter 7

1. d
2. d
3. a
4. c
5. b
6. a
7. b
8. c
9. d
10. b
11. d
12. c
13. a
14. a
15. b

Chapter 8

1. b
2. c
3. d
4. a
5. c
6. a
7. d
8. b
9. d
10. b
11. d
12. a
13. d
14. a
15. d
16. c
17. d
18. b
19. b
20. a

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1. b
2. c
3. a
4. b
5. d
6. c
7. a
8. c
9. a
10. c
11. a
12. a
13. a
14. b
15. c
16. b
17. c
18. d
19. c
20. d
21. b
22. b
23. d
24. d
25. a
26. c
27. c
28. b
29. c
30. a

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1. a
2. b
3. b
4. c
5. b
6. d
7. b
8. d
9. b
10. a
11. b
12. c
13. a
14. c
15. c
16. a
17. b
18. c
19. d
20. b

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